AD-A165 942 DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR) FY 1983(U) DEPARTMENT OF DEFENSE WASHINGTON DC 31 MAY 83 1/2

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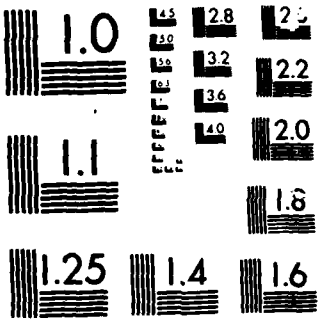


The Department of Defense

DoD Departments/Agency:

Department of the Army

Department of the Navy

Department of the Air Force

DARPA Defense Advanced Research Projects Agency

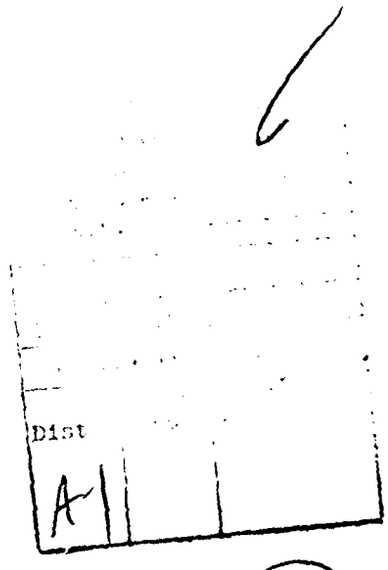
Defense Nuclear Agency

Closing Date: 31 May 1983

DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

FY 1983

PROGRAM SOLICITATION
Number 83.1
Small Business
Innovation Research
Program



U.S. Department of Defense

SBIR Program Manager

Washington, D.C. 20301

Closing date: May 31, 1983

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DOD PROGRAM SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH

1.0 PROGRAM DESCRIPTION

1.1 Introduction

The Department of Defense (DOD) and its Components (Army, Navy, Air Force, Defense Advanced Research Project Agency (DARPA), and Defense Nuclear Agency (DNA), (hereafter referred to as DOD Components) invite small business firms to submit proposals under this program solicitation entitled Small Business Innovation Research (SBIR). Firms with strong research and development capabilities in science or engineering in any of the topic areas described in Appendix D are encouraged to participate. DOD and its Components will support high quality research or research and development proposals on innovative concepts related to important defense-related scientific or engineering problems and opportunities that could lead to significant public benefit if the research is successful.

Objectives of the solicitation include stimulating technological innovation in the private sector, strengthening the role of small business in meeting Federal research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, increasing the commercial application of DOD-supported research results, and improving the return on investment from Federally funded research for economic and social benefits to the Nation.

1.2 Three Phase Program

This program solicitation is issued pursuant to the Small Business Innovation Development Act of 1982, Public Law 97-219. Under Phase I, DOD Components anticipate making awards during fiscal year 1983 to small businesses typically of the order of one-half to one (1) man-year effort over a period generally not to exceed six (6) months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under the SBIR program. The proposal should concentrate on that research or development which will significantly contribute to proving the scientific or technical feasibility of the approach or concept and which would be a prerequisite to further DOD support in Phase II.

Phase II awards are expected to be made during fiscal year 1984 to firms with approaches that appear sufficiently promising as a result of the first phase. Phase II awards are expected to typically cover 2 to 5 man-years of effort and to cover a period generally not to exceed 24 months, subject to negotiation. The number of Phase II awards will depend upon Phase I results and availability of funds. Phase II is the principal research or development effort; it will require a more comprehensive proposal, outlining the proposed effort in detail.

Under Phase III it is intended that non-Federal capital be used by the small business to pursue commercial applications of the research or development. Also, under Phase III, Federal agencies may award non-SBIR funded follow-on contracts for products or processes which meet the mission needs of those agencies.

Both Phase I and II contracts may include a profit or fee. This solicitation is for Phase I proposals only.

1.3 Follow-on Funding

In addition to supporting scientific and engineering research and development, another important goal of the solicitation is the conversion of DOD supported research or development into technological innovation by private firms. Therefore, on an optional basis, the DOD program includes an incentive for proposers to obtain a contingent commitment for private follow-on funding prior to Phase II to continue the innovation process where it is felt that the research or development also has commercial potential. Federal funding pays for research or development meeting DOD objectives (Phases I and II); private capital provides for follow-on developmental funding to meet commercial objectives (Phase III).

Proposers who feel that their research has the potential to meet market needs, in addition to meeting the DOD objectives, are encouraged to obtain non-Federal follow-on funding to pursue the development phase. The commitment should be obtained during the course of Phase I performance. This commitment may be contingent on the DOD supported research or development meeting some specific technical objectives in Phase II which, if met, would justify non-Federal funding to pursue further development for commercial purposes in Phase III. Phase II proposals that provide such a commitment for follow-on funding will receive extra consideration during the evaluation process.

The recipient will be permitted to obtain commercial rights to any invention made in either Phase, subject to the patent policies as stated in this solicitation.

1.4 Eligibility and Limitations

Each proposal must be limited to only one topic listed in this solicitation. When a proposal has relevance to more than one topic, the proposer must decide which topic is the most relevant and submit it under that topic only. However, a proposer may submit a separate proposal on different topics or different proposals on the same topic under this solicitation. If a proposal substantially the same as the one submitted in response to this solicitation has been previously funded or is either funded by, pending with, or about to be submitted to another Federal agency or another DOD Component, or to the same DOD Component as a separate action, the proposer must so indicate and provide the information required by Section 4.4(12).

This solicitation does not obligate the DOD to make any awards under either Phase I or Phase II. The DOD is not responsible for any monies expended by the proposer before award of any contract.

Each proposer must qualify as a small business for research or development purposes as defined in Section 2.2. In addition, a minimum of two-thirds of each SBIR project must be carried out by the proposing firm unless otherwise approved by the contracting officer.

Because of the scope and diversity of needs, availability of funds may (and probably will) preclude funding proposals which are nevertheless technically acceptable in some topical areas.

Joint ventures are permitted, provided the entity created qualifies as a small business in accordance with the Small Business Act, 15 USC 631, and the definition included in this solicitation.

2.0 DEFINITIONS

The following definitions apply for purposes of this solicitation:

2.1 Research or Research and Development - Any activity which is (A) a systematic, intensive study directed toward greater knowledge or understanding of the subject studied; (B) a systematic study directed specifically toward applying new knowledge to meet a recognized need; or (C) a systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements. In DOD's R&D Program the definitions A, B, and C above correspond respectively as follows: (A) Basic Research, (B) Exploratory Development and (C) Advanced Development or Engineering Development.

2.2 Small Business - A business concern, including its affiliates, which is organized for profit, is independently owned and operated, and at the time of award:

(1) Meets the size criteria for research and development of 500 employees or less and other regulatory requirements of 13 Code of Federal Regulations (CFR), Part 121.3-8 of Small Business Administration (SBA), Rules and Regulations, and Defense Acquisition Regulation (DAR).

(2) The primary employment of the principal investigator must be with the small business firm at the time of award and during the conduct of the proposed effort unless otherwise approved in writing by the contracting officer. Primary employment means that more than one-half of the principal investigator's time is spent with the small business.

2.3 Minority and Disadvantaged Business - A concern that is:

(1) At least 51% owned by one or more minority and disadvantaged individuals; or, in the case of any publicly owned business, at least 51% of the stock of which is owned by one or more minority and disadvantaged individuals; and

(2) Whose management and daily business operations are controlled by one or more of such individuals.

A minority and disadvantaged individual is defined as a member of any of the following groups: Black Americans; Hispanic Americans; Native Americans; Asian-Pacific Americans; or Asian-Indian Americans.

Attention will be given to a special outreach effort to ensure that minority and disadvantaged firms will have notice of this solicitation.

3.0 TECHNICAL TOPICS

3.1 Topic List

Topics for each DOD Component are listed and numbered separately. Topics and topic descriptions are provided in Appendix D.

4.0 PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

4.1 Proposal Requirements

The purpose of a proposal to DOD Components under the SBIR program is to provide sufficient information to persuade the DOD Component that the proposed work represents a sound approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria.

A proposal should be self-contained and written with care and thoroughness. Each proposal should be reviewed carefully by the applicant to ensure inclusion of data essential for evaluation.

The scientific or technical merit of the proposed research and development is the primary concern for all research and development supported by the DOD. A proposal may respond to any of the topics listed in Appendix D, or to specific subtopic areas within them, but must be limited to one topic or subtopic. An organization may submit separate proposals on different topics or different proposals on the same topic under this solicitation. Where similar research and development is discussed under more than one topic, the proposer should choose that topic whose description appears most relevant to the proposer's technical concept.

The quality of the scientific or technical content of the proposal will be the principal basis upon which proposals will be evaluated.

The proposed research or development must be responsive to the DOD program objectives, but can also serve as the base for technological innovation, new commercial products, processes, or services which benefit the public.

4.2 Proprietary Information

If information is provided which constitutes a trade secret, proprietary, commercial or financial information, confidential personal information, or data affecting the national security, it will be treated in confidence to the extent permitted by law, provided it is clearly marked in accordance with Section 6.7

4.3 General Content

This solicitation is designed to reduce the investment of time and cost to small firms in preparing a formal proposal. Those who wish to respond should submit a research or development proposal of no more than 20 pages, (no type smaller than elite on standard 8 1/2" x 11" paper) not counting the cost proposal. The proposal should be direct, concise, and informative. Promotional and non-project-related discussion is discouraged. To meet DOD Component requirements, all items are to be covered fully and in the order set forth below, but the space allocated to each will depend on the problem chosen and the principal investigator's approach. In the interest of equity to all proposers all information, except for the cost proposal, must be included in the 20 pages with no additional attachments.

It is not necessary to provide a lengthy discourse on the commercial applications in the Phase I proposal except to discuss them briefly under Section 4.4, items 3 and 4, as appropriate. The proposal must be principally directed at research or development on the specific topic or subtopic chosen.

4.4 Phase I Proposal Format

(1) Cover Sheet - Photocopy and complete the form in Appendix A as page 1 of each copy of each proposal. All pages shall be consecutively numbered.

(2) Project Summary - Photocopy and complete the form identified as Appendix B as page 2 of your proposal. The technical abstract should include a brief description of the problem or opportunity, project objectives, description of the effort and anticipated benefits. Potential applications of the proposed research or development should also be summarized in the space provided. The Project Summary of successful proposers may be published by the DOD and, therefore, should not contain proprietary or classified information.

(3) Identification and Significance of the Problem or Opportunity - Define the specific technical problem or opportunity addressed and its importance. (Begin on page 3 of your proposal.)

(4) Background, Technical Approach and Anticipated Benefits

a. Indicate the overall background and technical approach to the problem or opportunity and the part that the proposed research or development plays in providing needed results.

b. State the anticipated benefits of the approach if the project is successful and is carried over into Phases II and III. This should address the importance of the research or development to the total DOD research and development effort.

c. Discuss the significance of the Phase I effort in providing a foundation for Phase II research or development effort.

(5) Phase I Technical Objectives - Enumerate the specific objectives of the Phase I work, including the questions it will try to answer to determine the feasibility of the proposed approach.

(6) Phase I Work Plan - This section must provide an explicit, detailed description of the Phase I approach. The plan should indicate not only what is planned but how the work will be carried out. Phase I effort should attempt to determine the technical feasibility of the proposed concept.

The work plan should be linked with the objectives and the questions the Phase I effort is designed to answer. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.

(7) Phase I Statement of Work - The Statement of Work must summarize items 5 and 6 above by very briefly stating the principal project objective(s), identifying the tasks to be performed and the performance schedule, where appropriate. It should also identify the deliverable which for Phase I will be just one item, the Final Report.

(8) Facilities/Equipment - Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in Appendix C) shall be justified under this Section.

(9) Consultants - Involvement of university or other consultants in the planning and/or research stages of the project may be appropriate. If such involvement is intended, it should be described in detail and included in Appendix C (if appropriate). For Phase I, the total of all consultant fees, facility leases or usage fees and other subcontract or purchase agreements may not exceed 33% of the total funding agreement, unless otherwise approved in writing by the contracting officer.

(10) Related Work - Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, by the proposing firm, consultants, or others, how it interfaces with the proposed project, and any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic.

(11) Key Personnel - Identify key personnel who will be involved in Phase I effort including information on directly related education and experience. A resume of the principal investigator, including a list of publications (if any), must be included.

(12) Current and Pending Support - If a proposal substantially the same as the one submitted in response to this solicitation has been previously funded or is either funded by, pending with, or about to be submitted to another Federal agency, or another DOD Component or to the same DOD Component in a separate action, the proposer must provide the following information:

a. The name and address of the agency(s) or DOD Component to which a proposal was submitted, or will be submitted, or from which an award is expected or has been received (include contract number).

b. Date of proposal submission or date of award.

c. Title of proposal.

d. Name and title of principal investigator for each proposal submitted or award received.

e. Title, number, and date of SBIR Program Solicitations under which the proposal was submitted or award received.

f. Specify the applicable topics for each SBIR proposal submitted or award received.

(13) Cost proposal - complete the cost proposal in the form of Appendix C for the Phase I effort only. Under the direct labor category, list all key personnel by name as well as by number of hours dedicated to the project. The cost portion of the proposal must be stapled together with the rest of the proposal, but may be in addition to the 20-page proposal limitation.

4.5 Other Information

° Bindings - Please do not use special bindings or covers. Staple the pages in the upper left hand corner of each proposal.

° Packaging - All 10 copies of a proposal must be sent in the same package.

5.0 METHOD OF SELECTION AND EVALUATION CRITERIA

5.1 Introduction

Phase I proposals will be evaluated on a competitive basis. Proposals meeting stated solicitation requirements will be evaluated by scientists or engineers knowledgeable in the topic area. Proposals will be evaluated first on their relevance to the chosen topic. Those found to be relevant will then be evaluated using the criteria listed in Section 5.2. Final decisions will be made by the DOD Component based upon these criteria and consideration of other factors, including possible duplication of other research, and program balance. A DOD Component may elect to fund several or none of the proposed approaches to the same topic. In the evaluation and handling of proposals, every effort will be made to protect the confidentiality of the proposal and any evaluations. There is no commitment by the DOD Components to make any awards on any topic, to make a specific number of awards or to be responsible for any monies expended by the proposer before award of a contract.

For proposals that have been determined to be in the competitive range, a government contracting officer will draw up an appropriate contract to be signed by both parties before work begins. Any negotiations that may be

necessary will be conducted between the offeror and the government contracting officer. It should be noted that only a duly appointed contracting officer has the authority to enter into a contract on behalf of the U.S. Government.

Phase II proposals will be subject to a technical review process similar to Phase I. Final decisions will be made by DOD Components based upon the scientific and technical evaluations and other factors, including a commitment for Phase III follow-on funding, the possible duplication with other research, program balance, and budget limitations.

5.2 Evaluation Criteria - Phase I

The DOD components plan to select for award those proposals offering the best value to the Government with approximately equal consideration given to each of the following criteria, except for number one which will receive twice the value of any other item:

(1) The scientific/technical quality of the Phase I research proposal and its relevance to the proposal's stated objectives, with special emphasis on its innovation and originality.

(2) Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.

(3) Anticipated benefits of the research or development to the total DOD research and development effort.

(4) Adequacy of the Phase I proposed effort to show progress toward providing the feasibility of the concept.

Where technical evaluations are essentially equal in merit, cost to the Government will be considered in determining the successful offeror.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referred-to experiments. Relevant supporting data such as journal articles, literature, including government publications, etc., should be identified in the proposal.

5.3 Evaluation Criteria - Phase II

Detailed instructions regarding Phase II proposal submission will be sent by DOD Components to all Phase I award winners. Listed below are some of the principles upon which those instructions can be expected to be based.

A Phase II proposal can be submitted only by a Phase I awardee. It can be submitted at any time when progress attained under Phase I is deemed sufficient to justify the effort to be proposed under Phase II. It must contain enough information on progress accomplished under Phase I by the time of Phase II proposal submission to enable an evaluation of the project's promise if continued into Phase II. The Phase II proposal will

be reviewed for overall merit based upon the criteria below. Each item will receive approximately equal weight, except for item one, which will receive twice the value of any other item:

(1) The scientific/technical quality of the proposal, with special emphasis on its innovation and originality.

(2) The qualifications of the principal investigator and other key personnel to carry out the proposed work.

(3) Anticipated benefits to the importance of the research or development to the total DOD research and development effort.

(4) Degree to which the Phase I objectives were met at the time of Phase II proposal submission.

(5) The adequacy of the Phase II objectives to meet the problem or opportunity.

Phase II proposal evaluations may include on-site evaluations by Government personnel of the Phase I effort.

The reasonableness of the proposed costs of the effort to be performed will be examined to determine those proposals that offer the best value to the Government.

In the case of proposals of approximately equal merit, the provision of a follow-on Phase III funding commitment for continued development from non-Federal funding sources will be a special consideration. The follow-on funding commitment must provide that a specific amount of Phase III funds will be made available to or by the small business and indicate the dates the funds will be made available. It must also contain specific technical objectives which, if achieved in Phase II, will make the commitment exercisable by the small business. The terms cannot be contingent upon the obtaining of a patent due to the length of time this process requires. The commitment shall be submitted with the Phase II proposal.

6.0 CONSIDERATIONS

6.1 Awards

No contracts will be awarded until all qualified proposals on a specific topic have been evaluated. Contract awards for Phase I are expected to be made no later than September 30, 1983. DOD Components will announce the names of those firms receiving awards.

It is anticipated that a reasonable number of the Phase I awardees will receive Phase II awards, depending upon the results of the Phase I efforts and the availability of funds. Phase II is to further develop ideas explored under Phase I. Specific instructions for the preparation of Phase II proposals will be sent to Phase I awardees by the DOD Components. Those Phase II proposers who wish to maintain project continuity must submit proposals no later than 30 days prior to the expiration date of the Phase I contract and should identify in their proposal the work to be performed for the first four months of the Phase II work and the costs associated therewith.

Phase II proposers may be issued a modification to the Phase I contract, which may be issued at the discretion of the Government, covering an interim period not to exceed four months for preliminary Phase II work while the total Phase II proposal is being evaluated. This modification would normally become effective at the completion of Phase I or as soon thereafter as possible. Funding, scope of work, and length of performance for this interim period will be subject to negotiations. Issuance of a contract modification for the interim period does not commit the Government to award a Phase II contract.

Offerors for Phase II work who do not elect to submit a proposal 30 days prior to the expiration date of the Phase I contract, have the option to submit a proposal after the completion of the Phase I contract. The final date for receipt of a Phase II proposal will be June 30, 1984.

The period of performance under Phase II will depend upon the scope of the effort, but generally will not exceed 24 months. Phase II award decisions will be based upon evaluation of progress attained under Phase I and of the Phase II proposal. Phase II awards will typically cover 2 to 5 man-years effort, depending upon the scope of research or development.

Prior to Phase II, the DOD Component's Contracting Officer may request certain organizational, management and financial information for administrative purposes to assure that the applicant adheres to certain standards applicable to the type of contract contemplated.

6.2 Reports

Six copies of a final report on the Phase I project must be submitted to the DOD Component in accordance with the negotiated delivery schedule. This will normally be within thirty days after completion of the Phase I effort. The final report shall include a single-page project summary as the first page (use form, Appendix B) identifying the purpose of the work, a brief description of the work carried out, the findings or results, and potential applications of the effort in a final paragraph. The summary may be published by DOD and therefore should not contain proprietary or classified information. The balance of the report should indicate in detail the project objectives, work carried out, results obtained, and estimates of technical feasibility.

To avoid duplication of effort, language used to report Phase I progress in a Phase II proposal, if submitted, may be used verbatim in the final report with changes only to accommodate results obtained after Phase II proposal submission, and modifications required to integrate the final report into a self-contained, comprehensive and logically structured document.

6.3 Payment Schedule

Payments will be made in accordance with a payment schedule agreed to by the Contracting Officer. Requests for progress payments or advance payments based upon demonstrated need will be considered. The offeror shall include his cash flow requirements as part of the cost proposal submission for Phase I.

6.4 Technical Data

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this solicitation shall remain with the contractor, except that the Government shall have the limited right to use such data for Government purposes and shall not release such data outside the Government without permission of the contractor for a period of two years from completion of the project from which the data was generated unless the data has already been released to the general public. However, effective at the conclusion of the two-year period, the Government shall retain a royalty-free license for Government use of any technical data delivered under an SBIR funding agreement whether patented or not.

6.5 Copyrights

With prior written permission of the contracting officer, the awardee normally may copyright (consistent with appropriate national security considerations, if any) material developed with DOD support. DOD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

6.6 Patents

Small business firms normally may retain the principal worldwide patent rights to any invention developed with Government support. The Government receives a royalty-free license for its use, reserves the right to require the patentholder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the Government will not make public any information disclosing a Government-supported invention for a two-year period to allow the awardee a reasonable time to pursue a patent.

6.7 Markings and Treatment of Proposal Information

The proposal submitted in response to this solicitation may contain technical data and other data, including trade secrets and/or privileged or confidential commercial or financial information, which the proposer does not want disclosed to the public or used by the Government for any purpose other than proposal evaluation. To protect such data the proposer should type at the bottom of the cover page (page one) of his proposal the following notice.

> The data submitted on pages_____of this proposal have been submitted in confidence and contain trade secrets and/or privileged or confidential commercial or financial information, and such data shall be used or disclosed only for evaluation purposes, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this proposal, the Government shall have the right to use or disclose the data herein to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose data obtained without restriction from any source, including the proposer.

In addition, each page of the proposal containing proprietary data which the proposer wishes to restrict must be marked with the following legend:

> "Use or disclosure of the proposal data on lines specifically identified by asterisk (*) are subject to the restriction on the cover page of this proposal."

Those proposers that have classified facility clearance may submit classified material with their proposal. Any classified material shall be marked and handled in accordance with applicable regulations. Arbitrary and unwarranted use of this restriction is discouraged. Offerors must follow the Industrial Security Manual for Safeguarding Classified Information (DOD 5220.22M) procedures for marking and handling classified material.

The Government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event properly marked data contained in a proposal in response to this solicitation is requested pursuant to the Freedom of Information Act, 5 USC 552, the proposer will be advised of such request and prior to such release of information he will be requested to expeditiously submit to the DOD Component a detailed listing of all information in his proposal which he believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the proposer will ensure that any information released by the DOD Component pursuant to the Act is properly determined.

6.8 Price/Cost Proposal

A fixed price or cost plus fixed fee Phase I proposal must be submitted in detail in the format shown in Appendix C. Some items of Appendix C may not apply to the proposed project. If such is the case, there is no need to provide information for each and every item. What matters is that enough information be provided to allow the DOD Component to understand how the proposer plans to use the requested funds if the contract is awarded. Both Phase I and II contracts may include a profit or fee.

Special Tooling and Test Equipment, Material and Travel

Special tooling and test equipment and material cost may be included under Phases I and II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed.

The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. They may include such things as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired for the Government will be vested with the DOD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DOD Component.

Cost for travel funds must be justified and related to the needs of the project.

Cost-Sharing

Cost-sharing is permitted for proposals under this solicitation; however, cost-sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

6.9 Limitations

Restriction to Small Business

A small business must meet certain criteria to be eligible under this solicitation and certify to this on the Cover Sheet (Appendix A). See Section 2.2 for definition.

In addition, a minimum of two-thirds of each SBIR project must be carried out in the proposing firm and the primary employment of the principal investigator must be with the small business firm at the time of award and during the conduct of the proposed effort unless otherwise approved in writing by the contracting officer. Primary employment means that more than one-half of the principal investigator's time is spent with the small business.

6.10 Contractor Commitments

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. Copies of complete general provisions will be made available prior to award.

(1) Standards of Work. Work performed under the contract must conform to high professional standards.

(2) Inspection. Work performed under the contract is subject to Government inspection and evaluation at all reasonable times.

(3) Examination of Records. The Comptroller General (or a duly authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.

(4) Default. The Government may terminate the contract if the contractor fails to perform the work contracted.

(5) Termination for Convenience. The contract may be terminated at any time by the Government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.

(6) Disputes. Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.

(7) Contract Work Hours. The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).

(8) Equal Opportunity. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

(9) Affirmative Action for Veterans. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran of the Vietnam era.

(10) Affirmative Action for Handi apped. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.

(11) Officials Not to Benefit. No member of or delegate to Congress shall benefit from the contract.

(12) Covenant Against Contingent Fees. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bonafide employees or commercial agencies maintained by the contractor for the purpose of securing business.

(13) Gratuities. The contract may be terminated by the Government if any gratuities have been offered to any representative of the Government to secure the contract.

(14) Patent Infringement. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.

(15) Military Security Requirements. The Contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.

7.0 SUBMISSION OF PROPOSALS

7.1 Address

Proposals (10 copies) must be addressed to the DOD Component address provided at the beginning of each Component's section of this solicitation.

Handcarried proposals should be delivered to the mailing address indicated for each topic. Secure packaging is mandatory. The DOD Component cannot be responsible for the processing of proposals damaged in transit.

Do not send separate "information" copies or several packages containing parts of the single proposal.

One copy must be an original signed by the principal investigator and an official empowered to commit the proposer. Other copies may be photocopied.

7.2 Deadline for Proposals

Deadline for receipt (10 copies) at the DOD Component is 4:00 p.m. EST, May 31, 1983. Any proposal received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made, and: (1) it was sent by registered or certified mail not later than May 24, 1983; or (2) it was sent by mail and it is determined by the Government that the late receipt was due solely to mishandling by the Government after receipt at the Government installation; or (3) it is the only proposal received; or (4) it offers significant cost or technical advantages to the Government, and it is received before a determination of the competitive range has been made.

Any modification of a proposal is subject to the same conditions outlined above. The only acceptable evidence to establish: (1) the date of mailing of a late proposal or modification sent either by registered mail or certified mail is the U.S. Postal Service postmark on the wrapper or on the original receipt from the U.S. Postal Service. If neither postmark shows a legible date, the proposal or modification of proposal shall be deemed to have been mailed late. (The term "postmark" means a printed, stamped, or otherwise placed impression that is readily identifiable without further action as having been supplied and affixed on the date of mailing by employees of the U.S. Postal Service.); (2) the time of receipt at the Government installation is the time-date stamp of such installation on the proposal wrapper or other documentary evidence of receipt maintained by the installation. Notwithstanding the above, a late modification of an otherwise successful proposal which makes its terms more favorable to the Government will be considered at any time it is received and may be accepted. Proposals may be withdrawn by written or telegraphic notice received at any time prior to award. Proposals may be withdrawn in person by an offeror or his authorized representative, provided his identity is made known and he signs a receipt for the proposal prior to award. (NOTE: the term "telegram" includes mailgrams.)

8.0 SCIENTIFIC AND TECHNICAL INFORMATION SOURCES

DOD Technical Information Services Available

Persons preparing SBIR Program proposals to DOD, can strengthen them by contacting the Defense Technical Information Center (DTIC) for bibliographies of technical publications that have resulted from prior DOD R&D and for summaries of DOD sponsored work currently in progress in their proposal areas.

DTIC is the central source of scientific and technical information resulting from and describing R&D projects that are wholly, or partially funded by DOD. Searches of these collections of technical reports and other materials are performed at no cost to the requesters. Paper or microfiche copies of requested documents are normally provided for a nominal service charge. However, such materials needed for SBIR Program proposal preparation are available at no cost.

In addition to its information retrieval and related services, DTIC manages a program of nine DOD-sponsored Information Analysis Centers (IACs). These centers provide informational and consultative services performed by specialists doing R&D in subject and mission areas assigned to the IACs. Information about these and other DOD-sponsored IACs is available from DTIC.

DTIC can also identify other sources of scientific and technical information needed to prepare SBIR Programs proposals to DOD. Contact DTIC at one of the following locations:

Defense Technical Information Center
ATTN: DTIC-DDR
Building 5, Cameron Station
Alexandria, VA 22314
(202) 274-7633

DTIC Boston On-Line Service Facility
AFGL Research Library/SULL (Stop 29)
Building 1103, Hanscom AFB
Bedford, MA 01731
(617) 861-2413

DTIC Los Angeles On-Line Service Facility Defense Contract
Defense Contract Administration Services Region
11099 South La Cienega Blvd.
Los Angeles, CA 90045

Recognizing that small business may not have strong technical information service support, DTIC is prepared to give special attention to the needs of SBIR Program participants.

9.0 CONTACT WITH DOD

9.1 Oral Communications

Oral communications with DOD Components regarding this solicitation during the Phase I proposal preparation period are restricted for reasons of competitive fairness.

9.2 Questions Pertaining to This Solicitation

Any and all questions pertaining to this solicitation should be addressed in writing to the address listed at the beginning of each DOD Component listing of topics. No telephone requests will be accepted.

9.3 Requests for Additional Copies of This Solicitation

Additional copies of this solicitation can be ordered by writing to the following address: Defense Technical Information Center, DTIC/DDR, Attn: Reference Section, Cameron Station, Alexandria, Virginia 22314. Telephone requests will be accepted. Phone No. (202) 274-7633.

9.4 Information on Proposal Status

Evaluation of proposals and award of contracts will require approximately two months and no information on proposal status will be available until the final selection is made. However, contracting officers may contact any and all qualified proposers prior to contract award.

9.5 Release of Proposal Review Information

After final award decisions have been announced the technical evaluations of the proposer's proposal may be provided, to the proposer only, upon written request. The identity of the reviewer shall not be disclosed.

9.6 Correspondence Relating to Proposals

All correspondence relating to proposals should cite the specific topic number and be addressed to the DOD Component whose address is associated with each topic number.

10.0 ADDITIONAL INFORMATION

10.1

This Program Solicitation is intended for informational purposes and reflects current planning. If there is any inconsistency between the information contained herein and the terms of any resulting SBIR contract, the terms of the contract are controlling.

10.2

Before award of an SBIR contract, the Government may request the proposer to submit certain organizational, management, personnel, and financial information to assure responsibility of the proposer.

10.3

The Government is not responsible for any monies expended by the proposer before award of any contract.

10.4

This Program Solicitation is not an offer by the Government and does not obligate the Government to make any specific number of awards. Also, awards under this program are contingent upon the availability of funds.

10.5

The SBIR program is not a substitute for existing unsolicitated proposal mechanisms. Unsolicited proposals shall not be accepted under the SBIR program in either Phase I or Phase II.

10.6

If an award is made pursuant to a proposal submitted under this Program Solicitation, the contractor will be required to certify that he or she has not previously been, nor is currently being, paid for essentially equivalent work by any agency of the Federal Government.

10.7

If classified material is requested or classified work is proposed and involved, the Offeror to this solicitation must have security clearance in accordance with the Industrial Security Manual for Safeguarding Classified Information (DOD 5220.22M).

Proposal Cover Sheet

DEFENSE SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

NUMBER 83.1

Proposal Topic: _____ _____
Military Department/Agency — Topic (and subtopic) number

Proposal Title: _____

_____

Submitted By: Firm _____

Address _____

City _____ State_____ Zip Code_____

Submitted to: Department/Agency _____

Division _____

Address _____

City _____ State_____ Zip Code_____

Small Business Certification:

The above organization certifies it is a small business firm and meets the definition stated in the Small Business Act 15 U.S.C. 631 and in the Definition Section of the Program Solicitation.

Minority or Disadvantaged Business
Certification as follows:

"The above organization certifies that it_____ does_____ does not qualify as a minority or disadvantaged person or firm as defined in the Definition Section of the Program Announcement."

Disclosure permission statement as follows:

"Will you permit the Government to disclose the title only of your proposed project, plus the name, address, and telephone number of the corporate official of your firm, if your proposal does not result in an award, to firms that may be interested in contacting you for further information or possible investment?

Yes_____ No_____."

Number of employees for all affiliates (average for preceding 12 months):_____

Proposed Cost (Phase I):_____

PREVIOUS PAGE IS BLANK

Proposed Duration:_____ months (not to exceed six months).

Project Manager/Principal Investigator	Corporate Official (Business)
Name_____	Name_____
Title_____	Title_____
Signature_____	Signature_____
Date_____	Date_____
Telephone_____	Telephone_____

The data submitted on pages_____ of this proposal have been submitted in confidence and contain trade secrets and/or privileged or confidential commercial or financial information, and such data shall be used or disclosed only for evaluation purposes, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this proposal, the Government shall have the right to use or disclose the data herein to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose data obtained without restriction from any source, including the proposer.

APPENDIX B

U.S. DEPARTMENT OF DEFENSE

SMALL BUSINESS INNOVATION RESEARCH PROGRAM
PHASE I—FY 1983
PROJECT SUMMARY

FOR DOD USE ONLY

Program Office	Proposal No.	Topic No.

TO BE COMPLETED BY PROPOSER

Name and Address of Proposer

Name and Title of Principal Investigator

Title of Project

Technical Abstract (Limit to two hundred words)

Anticipated Benefits/Potential Commercial Applications of the Research or Development

COST BREAKDOWN

DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

Background: The following items, as appropriate, should be included in proposals responsive to the DOD Solicitation Brochure. As an alternative to the following items, the DD Form 633 (Department of Defense Contract Pricing Proposal) may be used. The DD Form 633 must be used if the price exceeds $500,000 for a proposal.

Cost Breakdown Items (in this order, as appropriate)

1. Name of offeror
2. Home office address
3. Location where work will be performed
4. Title of proposed effort
5. Topic number and topic title from DOD Solicitation Brochure
6. Total Dollar amount of the proposal (dollars)
7. Direct material costs
   a. Purchased parts (dollars)
   b. Subcontracted items (dollars)
   c. Other
      (1) Raw material (dollars)
      (2) Your standard commercial items (dollars)
      (3) Interdivisional transfers (at other than cost) (dollars)
   d. Total direct material (dollars)
8. Material overhead (rate ___%) x total direct material = dollars
9. Direct labor (specify)
   a. Type of labor, estimated hours, rate per hour and dollar cost for each type.
   b. Total estimated direct labor (dollars)
10. Labor overhead (specify company cost center)
    a. For each cost center identify overhead rate, the hour base and dollar cost.
    b. Total estimated labor overhead (dollars)
11. Special testing (include field work at Government installations)
    a. Provide dollar cost for each item of special testing
    b. Estimated total special testing (dollars)
12. Special equipment
    a. If direct charge, specify each item and cost of each.
    b. Estimated total special equipment (dollars)
13. Travel (if direct charge)
    a. Transportation (detailed breakdown and dollars)
    b. Per diem or subsistence (details and dollars)
    c. Estimated total travel (dollars)
14. Consultants
    a. Identify each, with purpose, and dollar rates
    b. Total estimated consultants costs (dollars)
15. Other direct costs (specify)
    a. Total estimated direct cost and overhead (dollars)
16. General and administrative expense
    a. Percentage rate applied
    b. Total estimated cost of G&A expense (dollars)

17. Royalties (specify)
    a. Estimated cost (dollars)
18. Fee or profit (dollars)
19. Total estimate cost and fee or profit (dollars)
20. The cost breakdown portion of a proposal must be signed by a responsible official, and the person signing must have typed name and title and date of signature must be indicated.
21. On the following items offeror must provide a yes or no answer to each question.
    a. Has any executive agency of the United States Government performed any review of your accounts or records in connection with any other government prime contract or subcontract within the past twelve months? If yes, provide the name and address of the reviewing office, name of the individual and telephone/ extension.
    b. Will you require the use of any government property in the performance of this proposal? If yes, identify.
    c. Do you require government contract financing to perform this proposed contract? If yes, then specifiy type as advanced payments or progress payments.
    d. Do you now hold any contract for the same or similar work called for by this proposed contract? If yes, identify.

D.1 ARMY SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

I INTRODUCTION AND GENERAL INFORMATION

1. The purpose of the Army's portion of the Small Business Innovative Research Program is to stimulate technological innovation and to use small business to help the Army meet its research and development needs.

2. This portion of the pamphlet is organized to facilitate timely submission of proposals by small businesses directly to the laboratory or agency which will ultimately evaluate the proposal. Listed in the next section are the Army points of contact for the Small Business Innovative Research Program and the addresses to which proposals should be submitted. In the third section are the specific research topics that the Army is interested in investigating through the Small Business Innovative Research Program. After each topic there is a cross reference to the appropriate point of contact.

3. Schedule

a. To be considered for this program, Phase I proposals must be received by the appropriate Army laboratory/agency not later than 31 May 1983.

b. Phase II proposals will be a follow-on to Phase I. Only these receiving Phase I awards will be eligible for Phase II. Submission of Phase II proposals should be coordinated directly with the appropriate Army laboratory/agency after the Phase I has been awarded.

c. Notification of Phase I awards and are expected to be made no later than 30 September 1983.

II POINTS OF CONTACT

Listed below are the addresses of the Army Laboratories and Commands to which Small Business Innovative Research proposals should be submitted. Each activity has a number which provides the cross reference to the Research Topics listed in the next section. The appropriate number of the activity to which a proposal should be sent is listed in parenthesis immediately following each topic.

1. CDR, Construction Engineering Research Laboratory
   ATTN: CERL-PP, Box 4005, Champaign, IL 61820

2. CDR, Cold Regions Research Engineering Laboratory
   ATTN: CRREL-PP, Box 282, Hanover, NH 03755

3. CDR, Engineering Topographic Laboratory
   ATTN: ETL-PRO, Ft Belvoir, VA 22060

4. CDR, Waterways Experiment Station
   ATTN: WESVB, Box 631, Vicksburg, MS 39180

5. CDR, Army Research Institute for Behavioral and Social Sciences
   ATTN: PERI-PO, 5001 Eisenhower Ave., Alexandria, VA 22333

6. CDR, Mobility Equipment Research and Development Command
   ATTN: DRDME-ZK, Ft Belvoir, VA 22060

7. Director, Army Materials and Mechanics Research Center
   ATTN: DRXMR-PP, Watertown, MA 02172

8. CDR, Missile Command
   ATTN: DRSMI-RN, Redstone Arsenal, AL 35898

9. CDR, Natick Laboratories
   ATTN: DRDHA-WA, Natick, MA 02760

10. CDR, Communications and Electronics Command
    ATTN: DRSEL-POD, Ft Monmouth, NJ 07703

11. CDR, Tank-Automotive Command
    ATTN: DRSTA-RGI, Warren, MI 48090

12. CDR, Human Engineering Laboratory
    ATTN: DRXHE-CC, Aberdeen Proving Ground, MD 21005

13. CDR, Aviation Research and Development Command
    ATTN: DRDAV-N, 4300 Goodfellow Rd, St Louis, MO 63120

14. CDR, Armaments Research and Development Command
    ATTN: DRDAR-RDR, Dover, NJ 07801

15. CDR, Electronics Research and Development Command
    ATTN: DRDEL-CT, 2800 Powder Mill Rd, Adelphi, MD 20783

16. PM Training Devices ATTN: DRCPM-IND
Naval Training Center, Orlando, FL 32813

17. CDR, US Army Medical Research and Development Command
ATTN: SGRD-RMA, Ft Detrick, Frederick, MD 21701

18. CDR, Ballistic Missile Defense Systems Command
ATTN: BMDSC-CPP (SBIR), Box 1500, Huntsville, AL 35807

III RESEARCH TOPICS

Our SBIR efforts are specifically directed to take advantage of technologies in which the US enjoys a lead and for which a need exists within the US Army. Our capabilities in areas such as automatic data processing and microelectronics represent national strengths that cannot be matched. By applying such leverage technologies we can develop and field equipment that will enable us to fight our kind of battle rather than an enemy's. With this focus in mind, a large share of the Army's SBIR funding will support work in the Thrust Areas that are listed as follows:

1. Very Intelligent Surveillance and Target Acquisition (VISTA)

Technology that will allow the incorporation of enormous computational power and data processing capabilities into individual sensors and combination of sensors. This area goes well beyond the technology embodied in the current surveillance and target acquisition systems. VISTA is intended to be an information gathering and processing system that provides real-time or near real-time target identification and location information to commanders at each level.

a. Knowledge Representation for Multisensor Correlation (15)

To automate the process of multisensor correlation, it is necessary to create a data structure which represents a history of objects, an incoming sensor report on an unknown item, and the inference machine to compare the new item to the library. Innovative techniques are needed to correct for a lack of speed in retrieval of an item from the library, inaccuracies in correlation when comparing an unknown to the library, and unwarranted growth of the data structures. Basic research needs to be conducted in the areas of data structures and predicate calculus.

b. Automated Intelligence Processing Algorithms (15)

This project area is in support of Joint Tactical Fusion Center (JTFC) development and other intelligence producing sensors. Current SIGINT and IMINT sensors produce data in the form of message traffic which will be collected, correlated, and fused together by analysts in the Joint Tactical Fusion Center. The project entails: Development of algorithms to automatically collect, correlate, and/or fuse sensor data to produce finished intelligence or assist the JFTC analysis: to accomplish their mission. Input/stimulus to evaluate developed algorithms will be in the form of message traffic which would be produced by a variety of intelligence collection sensors. Evaluation of the developed algorithm will be accomplished by comparison of algorithm results to ground truth of the scenario. Successful algorithms will ultimately be incorporated in fielded JTFCs. Potential contractors must possess a secure facility and have personnel assigned to the program who already have a Top Secret clearance and access to Sensitive Compartmented Information.

c. Improved Tactical Direction Finding Techniques (15)

The frequency ranges of interest are HF, VHF, and UHF. Primary concern is emitter location accuracy.

d. Frequency Independent Antennas and Couplers (15)

New design techniques and hardware validation demonstrations are required for frequency independent antennas and power amplifier matching networks for application in the frequency band below 30 MHz. The antenna should be lightweight, rapidly erectable and capable of operation while the vehicle on which it is mounted is moving. Techniques should also be developed for the band 20-400 MHz for small airborne vehicles such as unattended aerial vehicles.

e. Artificial Intelligence Applied to Communications EMC (15)

A brave robot jammer is required having the flexibility to sense its electrical signal environment and to devise the appropriate optimum jamming strategy. The AI program would control all analysis and control functions in the jammer, and be applicable to any size jammer, air or ground.

f. Automatic Tactical Performance Indicators (15)

Real-time and forecast atmospheric conditions for the battle area need to be combined using microprocessor techniques with capabilities of systems and units to give the expected performance of individual weapon and sensor systems, to the tactical commander.

g. Remote Atmospheric Sensing (15)

Visibility, wind velocity, temperature, and humidity affect the performance of electro-optical, artillery, and chemical systems. These atmospheric properties need to be measured remotely with lightweight, low-power consumption, automatic, reliable, and easily maintained, near real-time hardware.

h. Multisensor Signal Processing Techniques (15)

Develop signal processing techniques for multiple, colocated, tactical sensors and verify performance with computer simulations. The candidate sensors are thermal imagers, millimeter wave radar, carbon dioxide laser, and acoustics.

i. Field Demonstration of Target Acquisition (15)

The field computer (FPAD) program requires:

(1) 96-bit wide micro coding of image processing/radar processing/C02 laser processing/acoustic processing macro routines.

(2) Computer board fabrication for FPAD with limited and specified high throughput image processing functions such as hardware correlation and median filters.

(3) Computer to drive servo interface board design and construction for computer control of gimbles and data acquisition from flight instruments.

j. Computer Aided Design of Target Classifiers. (15)

The task would be the definition and development of a computer software package for the design and evaluation of statistical classifiers for image processing

applications to enable the computer aided design of Automatic Target Recognizer algorithms.

k. Development of Adjustable 3d Generation Power Supply for AN/PVS-7 (15)

Current Power supply design is based on furnishing discrete cathode voltage values. This requires fielding of an estimated four different power supply models to accomodate the various image tube oprerating requirements. Development of an adjustable design will allow a single power supply to be used, minimizing logistics costs and improving yields.

l. Signature Data Base Development (15)

Provide application programs which can access System 2000 data base through its procedural language interface. Provide software to generate synthetic imagery by inserting targets into different background images. Augment the information in this data base by entering target coordinates, target type, and performance statistics.

m. Intelligent Sensor Scoring System (15)

There is a need for the automatic recording of data from and scoring of cueing and tracker sensors. The development of special digital interfaces and digital recording equipment would allow reduction of data in a semiautomatic fashion and to have an insight to the overall functioning of these sensors.

n. Electronic Warfare Research (15)

(1) Research in ELIMI/ESM - Highly accurate, real time detection, identification, and location of noncommunication threats across the entire battlefield area is a primary concern. Antenna, receiver, and signal processing research is required for application to intelligence, VISTA targeting and responsive countermeasure activation.

(2) Research in Support Electronic Warfare - The major concern in this technology thrust area is jammer power management. Techniques applicable to stand-off, high power jammers and very lightweight, penetration jammers are of interest.

(3) Research in Self Protection Countermeasures - this thrust is concerned with advanced countermeasures research in detection, location, and identification of radar, heat-seeker, and electro-optical threats and techniques and countering these threats.

(4) Research in Vulnerability/ECCM - This area of technology addresses concepts for reducing the vulnerability of electronic US Army C-E Weapon Systems.

(5) Epitaxial Growth of Cadmium-Mercury-Telluride - Advanced growth technique with capability for growing multilayers of CdHgTe for advanced IR Detector Applications.

(6) Research on artificial intelligence techniques to improvements of EW Sensors, Jammers and interactive EW systems.

o. Development of Image Classification and Terrain Analysis Algorithms for Use in Terrain Analysis (2)

Image classification and terrain analysis algorithms need to be interfaced to operate on a mini-computer efficiently and at high speeds.

p. Development of a Battery-Powered Field Operational Severe Environment Data Logger (2)

Development and production of one or more portable, battery-powered data loggers for field operation in cold and/or severe environments to be applicable to meteorological, soil thermal and/or hydrologic measurements.

q. Snow Moisture Meter (2)

Construct a solid-state device for field use at low temperatures with low power consumption. Detect the liquid water content of wet snow with a liquid content in the range of 1 to 10% by volume. Operate in the megahertz frequency range using parallel plate capacitors or any other viable approach. Read out directly as a hand-held instrument or bury in snow and monitor remotely.

r. Radar Independent Meteorological Sensing System (4)

There is a need for a meteorological sensing system which does not require radar tracking to determine wind speed and direction at different altitudes.

s. The application of mathematical morphology to the problem of radar image feature extraction. (3)

Mathematical morphology has been used for image analysis in petrography, histology, study of cloud movements and computer reading. There are indications that mathematical morphology may be useful tool for terrain feature extraction from radar imagery.

t. Linear feature extraction from radar imagery. (3)

Develop methods and techniques to identify and extract automatically or semi-automatically line features from radar imagery. Line features are: e.g., road systems, railroads, rivers, and boundaries between area features.

2. Distributed Command, Control, Communications, and Intelligence

Development of dispersed, survivable command and control nodes with application down to the small unit level. The ultimate objective of this thrust is to design the architecture and systems to integrate battlefield information from all assets on the battlefield, distribute what is needed by each commander, and provide the opportunity for him to interact with a display/computer to permit precision fighting. Microchip technology, mass storage media, and interactive display technologies provide the technological development to accomplish dispersion command and control.

(5) Conceptual approaches to novel netted communication systems exploiting technological breakthroughs in microprocessors to yield orders of magnitude improvement in survivability against electronic and physical threats.

(6) Methods of exploiting short-term phenomena for reducing propagational losses, and translating these effects to product reliable special mode of communications techniques (for example, ducting, meteor burst, etc.).

(7) Improved low frequency air/metal coupling technques to yield higher efficiency and higher gain without resorting to larger array sizes, larger radiating elements, enlarged reflectors, etc.

(8) Self-adjusting failure prevention techniques associated with analytical behavior of solid-state component designs.

(9) ADP hardware and software techniques (commonality vs special purpose) for cells of a fluidly changing command post.

(10) Development of a machine for the composition and typesetting of Chinese text. This requirement is for psychological operations. (9)

3. Self-Contained Munitions

Operations on future battlefields require the employment of self-contained (brilliant) munitions that can seek out and destroy the target in a lock-on-after-launch mode without operator (gunner) assistance. These terminal homing munitions (weapon systems) must be viable in the adverse battlefield environments of smoke, dust, haze, fog, rain, and active/passive countermeasures. Targets will be both hard and soft ground targets and a wide variety of platforms. Launch of the engagement system may be from ground on air platforms.

Specific technology areas of interest include:

a. Indirect fire antiarmor submunitions (8,14)

b. Autonomous acquisition algorithms and processors (8)

c. Midcourse inertial guidance techniques and components (8)

d. Minimum signature propulsion (8)

e. Air-breathing propulsion (8)

f. Fiber composite structures and materials applications (8)

g. Fiber optic guidance technologies (8)

h. Kinetic energy kill mechanisms (8,14)

i. Millimeter wave and submillimeter wave technology (8, 14, 15)

j. Aerodynamics of maneuvering projectiles (8)

k. Passive sensing (14)

l. Automatic control (14)

m. Artificial Intelligence (12)

n. Automatic recognition (8, 14, 15)

o. Propellant chemistry (14)

p. Electro-optics (15)

q. Dynamics of Projectile Penetration in Snow (2)

Develop constitutive equations for projectile penetrations in snow. Must consider both blast effects as well as physics of projectile penetration of explosive munitions. Final form should be simplified for engineering applications.

4. Biotechnology and Chemical Defense

Research and development efforts which emphasize the application of novel technologies, such as genetic engineering, and treatment of casualties on the integrated battlefield to include development of vaccines and antidotes. In addition, because of delays in evacuation or treatment, traumatic shock requires that research be performed to develop new treatment compounds, analgesics, and blood substitutes.

a. Chemical/Biological Agent Detection (14)

(1) Real Time Measurement of Spray Time Drop Sizes. Measurement of the size of liquid drops at the time of dissemination is needed to assess their actual configuration. Techniques are required to accurately measure the size and shape of liquid drops from the instant the liquid is disseminated until it hits the ground.

(2) Infrared (IR) Detector for Ambient Temperature Use. Laboratory demonstration of IR detector to replace cryogenically cooled Hg $Cd_{\frac{1}{2}}Te$ detector should operate between 8 and 12 um with a D* of 3.5×10^{10} CM $HZ^{\frac{1}{2}}$ watt desired.

(3) Passive Detective Techniques. Proof of principle demonstrations of passive (non energy emitting) IR, UV, or microwave techniques for the detection of the following: (a) Chemical agent simulate aerosols (concentration path length 5 to 50 MG/M^2 particle size to 10 micrometer). (b) Chemical agent simulant ground contaminatlon (1 to 3 GM/M2). (c) Biological aerosols (bacterial virus, richettsia 5 x 10 10 particles/M^2).

(4) Simple Lightweight Spectroradiometer. Concepts and design development of simple lightweight specroradiometer operating between 8 and 12 UM wlth a 4-CMl resolution. System should use few or no moving parts and have a noise equivalent spectral radiance of $1.5 \times .10^{9}$ W/CM^2 ER CM-1 at 1000 CC1 and a field of view of 1.5^0 by 1.5^0. Use of "solid-state" fourier transform spectrometer or enhance steady grating spectrometer should be considered.

(5) Evaluation of Criteria for Spectral Pattern Recognition. Evaluation of linear discriminant functions, fisher discriminants variable increment classifers, as well as other techniques to determine best approach to

solve the spectral pattern recognition problem for IR passive remote detection.

(6) Submicron Particle Analyzer. Automated, in situ analysis of aerosols of various materials and shapes in submicron sizes.

b. Chemical/Biological Agent Protection (7, 9)

(1) Materials Research. Materials suitable for protective mask, agent impermeable, transparent.

(2) Textile Technology. Agent impermeable textiles.

c. Materials Resistive to Chemical Warfare (CW) Agents and Decontamination (7)

A variety of rubber-type, neoprene and plastics appear to be adversely affected by decontamlnation solutions/procedures after contamination by CW agents. A need exists to derive new/substitute materials for those traditionally used in combat vehicles and which also exhibit either improved resistive or survivable characteristics to the vehicle/CW environments.

d. Battlefield Smoke (14)

(1) Smoke Clearing Techniques. Practical methods to clear large areas of smoke particles using low logistic techniques.

(2) Deagglomeration of Powders. Practical methods to break up Powders into individual particulates immediately prior to dissemination. Air and electrical power are believed to be the most practical methods to drive the device.

(3) Methods to Transfer Powdered Smoke Agent. Transfer powdered smoke agent from its storage container to the using device. The flow rate should be uniform but selectable, run without operator assistance, and efficiently transfer material so that little is left in the storage container.

(4) Treating and Packaging Techniques. Treat powdered smoke agent to prevent caking during storage. Packaging the treated powder in single trip containers to provide protection for extended storage in a field environment.

(5) Electrostatically Charged Dielectric Powders. Provide devices to charge relatively large mass flow rates of dielectric powder to selectable levels.

e. Water Purification Method (1)

Portable units capable of purifying polluted surface or ground waters from any of a variety of contaminants would be an asset under wartime conditions.

5. Soldier Machine Interface

The transfer of operational burdens to the machine and a reversal of the trend toward manpower intensive systems. This area seeks exploitation of our society's unique abilities and opportunities to interface with computers. The

objective is to maximize combat power by optimizing performance of both soldiers and equipment, individually or in combination and to achieve effectiveness equal to design capabilities of a system while not increasing a requirement for human skills not currently available in typical Army units.

a. Soldier Performance

The major challenges for soldier Performance data in the future reside in the computer interface to include software, operations under adverse conditions, and basic data on today's soldiers capabilities. Secondly, operation under adverse conditions, particularly, in projected NBC Threat environment, will require much attention in the future. To conduct operations in this environment will require an assessment of the capabilities of the soldier and his protective equipment in such environments. Lastly, more data must be acquired on soldiers' capabilities, physical and mental. These basic data must be acquired to preclude the development of systems whose operation and maintenance exceed the soldiers ability.

b. Maintenance Capability (13)

Use of artificial intelligence (AI) to improve maintenance capability and productivity. As our systems become more complex, their maintenance becomes more difficult. The knowledge required to fault isolate and repair these systems can be stored in a computer. A small, portable, interactive computer equipped with AI and graphics can be an invaluable assistance to the maintenance personnel. This technology should be exploited to increase the capability and productivity of maintenance personnel.

c. Robotic Vehicles to Detect and Neutralize Mine Fields and Barrier Ordnance (6)

Technologies are needed to enable tactical robotic vehicles to transit the battlefield ambient terrain, arrive at their mission point, and conduct barrier ordnance, mine detection, and neutralization functions.

Sensing close-in terrain features and obstacles from vehicles and provisions of output to enable automated decision making for the robot to go over, go around, descend, or avoid the terrain feature or obstacle.

Processes and hardware for interface of sensor information, directional decisions, and vehicle controls to effectlvely enable a tracked vehicle to transit amblent battlefield terrain given as assigned course.

d. Automated Ammunition Loading of Combat Vehicle (12)

Concepts for developing a system using robotics technology to rapidly handle palletized/utilized ammunition in a forward area.

e. Trainlng (16)

Emerging technologies such as artificial intelligence (AI), voice synthesis and recognition, and computer-aided instruction (CAI) should be exploited to optimize the cost effectiveness of new training systems. Technological advancements are needed to provide for engagement simulation on an obscured battlefield and

military operations in urban terrain (MOUT).

f. Heat Exchanges Used in Vapor/Air Cycle Combat Vehicle Crew/Compartmei Cooling Systems (11)

A need exists for high-performance, reliable, rugged, compact heat exchangers used as evaporators or condensers in air-to-air, refigerants-to-air, coolant-to-air, and refrigerants-to-coolant heat exchangers. These components are required to perform in typical combat vehicle induced environments of high dus concentrations/ingestion, temperatures, shock, vibration, salt spray, NBC contamination/decontamination, petroleum products, etc.

g. Helicopter Cockpit Ergonomics (13)

The pilot will be a critical limitation on mission performance in advanced helicopters such as the LHX. The designer can provide more capabilities and systems than the pilot can possibly exploit; many of his tasks will have to be automated, and the tasks that remain will have to be made easy to perform. There is a need for increased research to define what must be automated, and the modalities for all controls and displays.

h. Assessing Cognitive Capabilities (5)

The focus of this area of research is to assess the cognitive skills and abilities which individuals bring with them to any given situation. The following are three areas of specific concern:

(1) Analysis of Individual Cognitive Skills. Greatest concern to the Army is the development of methods for measuring skills or intelligence of individuals. Testing procedures that will provide this information are critical.

(2) Abstract Conceptual Ability. Particular interest is in how levels of abstrac' conceptual functioning relate to different levels of skills or placement within an organization.

(3) Measurements for Job Performance: Research needs to develop methods by which an individual's performance of job tasks, and how the performance relates to overall unit performance can be assessed.

i. Instructional Techniques and Systems (5)

In an era of rapidly changing technology and soaring training costs, there exists the need to develop more rapid and efficient methods and systems for providing instructional training and retraining. This area includes three major subelements:

(1) Instructional Strategies. This research area involves methods for developing a better understanding of the ways by which individuals acquire new information (Individual Learning Strategy) and discovering the methods individuals use once they become proficient in solving particular analytic problems when they discard the linear paradigm by which they were taught (Analytic Reasoning Strategies).

(2) Computer-Based Instruction. Despite recent progress in computer-based instruction (CBI) the areas of psychomotor skills training and performance measurement criteria need additional investigation in order to maximize the beneflts of CBI.

(3) Expanding Learning Skills. Overcoming perceived natural limitations and improving an individual's ability to learn are current research needs.

j. Cognitive Processing Limitations (5)

Questions concerning the limitation on human cognitive processing and what can be done to compensate are critical elements in this research effort.

(1) Man-Machine Integration. The overriding concern is to develop design guidelines to insure that future systems are compatible with the intended human user. Specifically, the research must look at optimum allocation of tasks to the human and the machine.

(2) Information Overload. Research should develop a schema for packaging information to assist with the overload condition under various levels of operational load and time pressures.

(3) Decision making. How people make decisions, what type of information they use, in what sequence they need the information, and what the actual processess are by which they arrive at a decision comprise this area of concern.

(4) Group Decisionmaking. Future systems will probably require decision making by groups of varying sizes not collocated. Research in this method of decision making is necessary if future systems are to be completely utillzed.

k. Artificial Intelligence Application (5)

Many of the new systems and modified existing systems will require applications of Artificial Intelligence (AI). Necessary and sufficiently minimal conditions for symbolic processing must be explored. Research needs to be conducted in the following areas:

(1) Learning. This should include methods to incorporate new lnformation from the outside environment into an existlng data base.

(2) Knowledge Representation. This area should examine the construction and modification of the world view, coding, collating, organizing, storing, and retrieving input information, representation of expert knowledge and machine creativity.

(3) Problem-Solving. Areas for research include: heuristic problems solving, rule-based problem-solving, goal-directed problem-solving, nonlinear problem solving, inductive reasoning, and distributed problem solving/network control.

(4) Planning. Machine planning is critical to any true AI system.

The areas of research need to include structure planning, goal generation, incorporation of the user's value judgments, constraint modification and alternatives, distributed planning, generic planning, and meta planning.

1. Artificial Intelligence/Robotic Supplement to Medical Support (17)

Tremendous numbers of casualties can be expected on the battlefields of the future. This influx of casualties may overwhelm traditional systems for casualty retrieval, transport, and treatment. The potential exists to use computer-controlled devices to detect casualties on the battlefield, determine if they are still living, and allocate resources to retrieve them. It is even conceivable that robots could carry out, or at least assist in, the actual retrieval. Computers could assist in the diagnosis at the aid station and in administering therapeutic measure during transport to better medical facilities.

6. Medical Support

Success in battle requires healthy troops. Disease can threaten the success of military operations, as can the hazards generated by our own systems. Just as effective medical defense must be developed and made available to protect the soldier against infection or contamination, research must also be conducted to define the hazards of our systems and to devise standards and methods to protect our personnel against them. In the field, the objective is to improve prevention and treatment of disease, particularly those exotic diseases endemic to areas where American soldiers may have to fight. In addition, new types of weapons will be appearing and medical research must be conducted to determine how these weapons will affect personnel and to help devise ways to protect personnel.

a. Diagnosis of Natural and Induced Diseases of Military Importance (17)

This effort is designed to provide state-of-the-art technology to develop a system for rapid identification and diagnosis of agents or diseases acquired naturally or by exposure to biological weapons. The system will provide for rapid identification of agents/diseases through examination of clinical specimens such as blood, urine, spinal fluid, and throat washings. The system should be extremely sensitive using very specific reagents such as monoclonal antibodies prepared through hybridoma technology. Methods utilizing the latest in biotechnology techniques should be utilized, such as labeled molecular probes for the identification and analysis of microbes or their products.

b. Subunit Vaccines for Militarily Important Diseases (17)

Subunit vaccines are those which are composed of key portions of killed microrganisms. The aim of this effort, therefore, is to rid the killed microrganism of undesirable components by utlizing the techniques of microbial engineering and identifying just those parts of an organism that are able to produce immunity without side effects and to utilize genetic engineering to produce these purified antigens in large quantities.

c. Ballistic Injury (17)

Basic medical research is needed to differentiate wounding effects from high-

velocity missiles as compared to low-velocity missiles and the effect of these differences in treatment regimens.

d. Burn Injury (17)

Feasibility studies are required to construct appropriate animal models to permit research on the physiologlcal and biological systems affected by burn injuries. Specific areas requiring research are: role of surface active agents in burn inhalation injury and how these can be artificially constructed and used; cellular reaction to burn inhalation injury and methods for treatment; and role of artificial skin in covering burn wounds and prevention of infection.

e. Design and Synthesis of Novel Compounds as Pretreatment, Prophylaxis and Antidotes for Chemical Warfare (CW) Agents (17)

New compounds based on rational scientific premise are required for evaluation to protect and/or treat personnel exposed to CW agents. These agents include the nerve agents, hydrogen cyanide, mustard, and Lewisite. Effectiveness, toxicity, ease of synthesis, and scale-up potential are important considerations in the design of these compounds.

f. Innovative Approaches for Decontamination and Detoxification of CW Agents on Skin (17)

The rapid inactivation and/or removal of toxic CW agents from skin is an important consideration in the event of chemical exposure. New approaches compatible with human use and having the potential of meeting FDA guidelines are required for evaluation as potential skin decontaminants.

g. Mechanisms of Action of Mustard (17)

The vesicant agent, mustard, produces a high morbidity for unprotected personnel. Little is known of the mechanism of action of mustard so that effective protection and/or treatment can be developed. Studies should attempt to define the etiology of mustard poisoning to aid in the development of effective countermeasures.

h. Vital signs Monitor (17)

There is a continuing need for innovative approaches to noninvasive, real-time measurement of vital signs of casualties who are enveloped in chemical protective overgarments. Current detection capabilities are for heart rate, blood pressure, and respiratory rate. Long-range planning enivisions the need for smaller and lighter devices with the capability to nonninvasively measure additional vital signs.

i. Resuscitation (17)

There is a research requirement in the area of resuscitation. Innovative approaches to casualty resuscitation using manual or external powered devices are needed. Developmental criteria include small size, minimum weight, and simplicity of operation. The manual devices must be designed for use by nonmedical personnel to provide emergency resuscitatlon for chemical casualties

without creating additional exposure hazard to the casualty.

j. Patient Dosimetry (17)

There is a critical need for innovative research and ultimate development of dosimetry methodology to: (1) determine exposure to chemical agents, including type of agent; (2) determine exposure dose; and; (3) determine adequacy of decontamination. While the ultimate goal is a single device to accomplish required functions, innovative ideas addressing one or more required functions are required.

k. Attenuated Vaccines for Militarily Important Diseases (17)

Attenuated vaccines are those that include living disease microorganisms that are not virulent enough to cause disease when inoculated into healthy lndividuals. Yet the attenuated vaccine wlll stimulate immunity in an individual against virulent forms of the disease organisms. The objective of this effort is to employ genetic manipulative techniques to alter the virulence of disease organisms so they can be used in attenuated vaccines. Effective vaccines are needed against natural diseases and potential biological warfare agents.

l. Health Effects of Directed Energy Weapons (17)

The potential exists for the development of laser and microwave weapons. If these are developed, medical research must be conducted to determine how these weapons can damage the body, how this damage can be prevented, and how it can be treated once it occurs.

m. Field Water Supply (17)

Water has often been a major factor in deciding the outcome of battles in areas where it is very scarce or where it has been contaminated, either naturally or by man. Preventive medicine personnel must periodically test both the raw water sources and the treated water to insure that it is safe for use by military personnel. Medical research is needed to modernize the test equipment provided to these preventive medicine personnel. Technologies used in current test kits is sometimes over 20 years old and can be very slow and inaccurate. Field equipment is not available to detect and analyze chemical and biological warfare agents at the levels which may have health impacts at the water consumption levels expected in arid environments.

n. Temporary Dental Restorative Material (17)

There is a continuing need for a temporary dental restorative material for rapid treatment of dental caries in the field and during mobilization. The material should have the following characteristic: be compatible with dental and oral tissues, requires little or no cavity preparation and be technique insensitive in order that it may be used by semiskilled dental auxiliary personnel: remain functional approximately 12-18 months, not require special storage conditions, and remain stable over a wide range of temperature/humidity conditions.

o. Tissue Adhesive (17)

A biocompatible adhesive(s) is required for rapid treatment of soft and hard tissue wounds.

p. Dental Anesthesia (17)

Dental treatment in the field by semiskilled dental auxiliary personnel requires a rapid, noninvasive method for selective anesthesia to individual teeth.

q. Dental Screening System (17)

Mobilization of large numbers of personnel necessitates examination for dental pathology. A rapid, automated system is required to screen and identify troops at risk of experiencing a dental emergency in order that they can be treated.

r. Bone Substitute (17)

Biocompatible synthetic materials or despeciated bone are required for repair/replacement of bone to elimiate secondary surgical procedures to obtain autogenous bone for grafting.

s. Wound Dressing (17)

Due to delayed evacuation for definitive treatment a field bandage is required which can control hemorrhage, infection and pain.

t. Sterilization (17)

A nonautoclaving method for rapid sterilization of surgical and dental instruments, operating room linens, and other supplies is required in forward areas to reduce the quantity of instruments/supplies needed and logistical support.

u. Field Equipment (17)

Surgical, medical, and dental diagnostic and treatment items and equipment systems used by units deployed in forward combat area must meet the following requirements: small cubic size, lightweight (individual items must be one/two-person portable), energy and resource efficient, and resistant to mositure or chemical agent contamination. Electronics, where required, must have a multisource capability, be electromagnetic pulse resistant, and capable of modular replacement.

v. Cleansing (17)

A non-water-requiring skin sterilization system for hand cleaning and operative site preparation is required for forward field use. Also, a non-water-requiring bathing system that does not dry the skin is required for soldlers' personal hygiene as well as nonirritating depilatory.

w. Drugs (17)

A short-acting (onset 30 minutes - duration 6 hours) nonsedating anxiolytic that does not interfere with mentation is needed in treatment of psychiatric battle casualties.

x. Suction Device (17)

A lightweight device providing controlled suction over a range 10-100 cm water powered other than electrically is needed for various tube and operative site usage.

y. Infusion Device (17)

A nongravity-dependent intravenous infusion device that can deliver measured amounts of fluids at a constant reliable rate without technical supervision is needed for mass casualty and transport of wounded.

z. Laboratory (17)

A rapid, simple, accurate and reproducible method of urine, serum sodium, potassium, chloride, creatine, blood glucose, and urea nitrogen as well as blood ph, oxygen, and carbon dioxide determinations is needed.

7. Combat Equipment and Materials

Support of future armies calls for development of new and improved materials and equipment. New metals with improved armor capability are always important, while requirements for more adaptive, fuel-efficient, and mobile equipment are emerging. In the area of combat equipment, the following subtopics are suggested for investigation:

a. Improved Propellers/Propeller Coating for Erosive/Corrosive Environment (6)

Operation of Army air cushion vehicles in amphibious resupply across beach areas results in extreme erosive effects of sand and water coming in contact with propellers. Development of materials/coatings for propellers to decrease the erosive/corrosive effects of the military environment are needed.

b. Portable Electrical Generating and Power Conditioning Equipment for Field Use (6)

Portable electric power units currently deployed are used in very large quantities consuming about one-quarter of available mobility fuels. Current R&D is focused on fuel cells, thermo-electric and photo-voltaic systems, and advanced types of internal and external combustion engines with associated electrical components and controls. New technologies are needed which will reduce costs; improve reliability, maintainability, and efficiencies; be capable of operating on alternate fuels; and have reduced acoustic and thermal radiation. Power conditioners are necessary to convert indigenous power sources to US standard voltage and frequency. They must be compact, durable, lightweight and long-lived for deployment in hostile environments and operated by semiskilled personnel.

c. Development of Technologies that will Allow Army Equipment to Operate on a Variety of Fuels as They Become Available (6)

Current fuels research is addressing alternative fuels, and fuels derived from renewable biomass sources. Technology is required to permit interchangeability

of fuels in standard field equipment.

d. Portable Vehicle Engine Exhaust Water Recovery/Treatment System (6)

Water can be potentially produced from engine exhaust gases. A system capable of recovering and testing water from vehicle engine exhaust gases could be used to develop a vehicle closed loop water support system. The development of a closed loop system such as developed by NASA to support spacecraft operations is especially important in a highly mobile integrated battlefield.

e. Chlorine-Resistant Reverse Osmosis Elements (6)

Develop chlorine-resistant reverse osmosis elements to allow prechlorination of water for the Army's new reverse osmosis water purification unit.

f. Research in Advanced Composites (7)

(1) Feasibility of using ultrasonic excitation to enhance the liquid resin infiltration of glass fiber and graphite fiber in the preparation of organic matrix composites. An analogous study could be undertaken for the infiltration of molten metal into tows of graphite fiber and silicon carbide fiber in the making of metal matrix composites.

(2) Hybrid composite materials for structural applications: Army applications such as aircraft, missiles, remotely piloted vehicles, ground vehicles and artillery require advanced materials for improved mobility and combat effectiveness. Effort in this area would include methodology and determination of required structural design criteria. Materials under consideration include hybrid composites containing more than one reinforcing fiber as well as composites composed of differing materials; i.e., ceramics/organic composites and similar combinations.

g. Research in Ceramic Material (7)

Feasibility of forming net-shape ceramic parts by self-propagating stoichiometric reaction in a closed container. The reactants could be either in the liquid, solid, or gaseous state and exothermic reactions, once initiated, would be self-propagating to completion. The physical structure of the product would seem to be related to the ratio of the reaction temperature to the melting point of the product. It may be possible to "cast" high melting-point ceramics such as silicon nitride to complex net shapes by this means.

h. Non-Newtonian Fuel Additive (6)

Investigate feasibility of using additives for drag reduction in military fuel pipelines and hoselines of six to eight inches in diameter; type of additives, method of application, costs and benefits, sources of supply.

i. Attenuation of Noise Sources from Various Components Used in Military Vehicles (See subparagraphs below)

(1) Development is needed of a means to isolate the operators in the operator's compartment from the high propeller noise environment on air cushion vehicles. Noise level reduction from 99 to 85 DBA is desired. (6)

(2) A variety of electrical/hydraulic motors, pumps, fans, and blowers employed within combat vehicle crew compartments contribute to uacceptable noise impositions on crew members. Acceptable methods of acoustic control/reduction for these kinds of components would assist in resolution of the problem. (11)

j. Automated Diagnostic Equipment (6)

A solid-state data recorder providing diagnostic data and real-time information on duty cycles of electric power generating equipment is necessary to predict maintenance requirements, define mission profiles, and validate equipment sizing. This type of automated equipment would record voltages, current, power, frequency, pressure, duration, and energy with frequency or time of occurrence.

k. Corrosion Research on New Materials (6)

New alloys and nonoxide ceramic materials are under consideration for replacement of "superalloys" in military equipment. New corrosion prevention technologies must be developed for these materials to retain the necessary high-strength characteristics.

l. Urban Warfare Explosives Detector (6)

Future military operations in most areas of the world will involve fighting in urban terrain. High speed, portable devices are required to detect and locate the explosive contents of mines, booby traps, demolition charges, and remotely activated munitions concealed within this terrain.

m. More Efficient Utilization of Fuel in Light Trucks and Off-Road Vehicles (11)

Current research is focusing on adiabatic diesels, ceramic components in gas turbines, and advanced transmissions. New technologies are required in fuel management and/or high-strength materials for power trains which will provide reduced weight and increased fuel economy.

n. Lightweight Materials and Materials Systems with Improved Armor Capability (7)

The primary threats to armor systems include small, medium, and large caliber weapons as well as chemical energy warheads. These threats have shown a steady growth in lethality such that protection with conventional armor requires prohibitively high weights.

o. Joining Technology (7)

More effort is needed in the development of joining technology for difficult-to-weld materials or material combinitions used in present and planned Army systems. Such materials would include ultrahigh hard steels, matrix composites, and ceramic/metal combinations. In addition, the development of automated welding and thermal cutting systems utilizing adaptive controls is needed.

p. High-Density Kinetic Energy Penetrators (7)

One of the primary threats to tank armor is high-density kinetic energy penetrators. Because of the increased armor protection it is necessary to produce a penetrator with better ballistic performance. At the present time the penetrators are fabricated from staballoy (depleted uranium) or tungsten alloys. All future penetrators that are to be used in the large caliber gun systems (120 mm) are scheduled to be fabricated from staballoy. This material (Staballoy) constitutes a health hazard because of its toxicity. Therefore, it is imperative that an intensive research program in tungsten materials be initiated to improve the mechanical properties of tungsten materials that will achieve the ballistic performance of staballoy and eventually replace staballoy as a penetrator material.

q. Manufacturing Methods for the Economic Application of Lightweight High-Performance Materials (7)

Effort would include demonstrating the feasibility of manufacturing techniques for producing components from lightweight materials for those applications in in which high strength/weight or high stiffness/weight ratios are required.

r. Measurement Techniques Instrumentation and Automatic Test Equipment (7)

Work involving high-frequency ultrasonic equipment in the 30- to 100-MHz range, with the objective of inspecting smaller critical flaw sizes. Development of software for automated test equipment, with the objective of eliminating human error during the inspection process.

s. Fatigue Indicator (6)

A concept is required for indicating and/or measuring the amount of structural fatiguem a component. The approach may consider such methods as visual, ultrasonic, chemical, mechanical, and electrical that wlll reliably measure and indicate the expended structural life. The device/system must be rugged, self-sufficient, and easily operated in order to be useful and survive in the typical environments experienced by military bridges.

t. Marker Beam for Roof Moisture Surveys (2)

Develop source of beamed electromagnetic energy for use in nondestructive testing to locate wet insulation in roofs on buildings.

u. Portable Ground Water Flow Measurement Device (2)

Develop battery-operated device for determining direction and rate of ground water flow in test holes.

v. Accurate Metal Detector (2) - Develop a subsurface metal detection device effective to a depth of 36" within ½" accuracy.

w. Alternate Fuels for Facilities (1) - Develop alternate fuels for heating fixed military facilities.

x. Construction Technology Forecasts (1) - Conduct technology forecasts and assess potential impact on military construction.

y. Artificial Intelligence for Building Design (1) - Develop artificial intelligence applications for use in automated design of military facilities. Potential for application exists in automated design systems that are being implemented by the Army Corps of Engineers.

z. Air Surface River Ice Thickness Measurement Device (2)

There exists a need for a device to measure (nondestructively) fresh water ice thickness from the upper ice surface on frozen lakes or rivers. The handportable device should be capable of making point (maximum 6-inch-diameter area) measurements of ice thickness. The transducer may, but need not, contact the ice surface.

aa. Cold Weather Pavement Material (2)

Development of a quick-setting material which can be poured or blown into larger cavities or depressions at temperatures of 0°F and which would reach an unconfined compressive strength of 300 psi within a few hours.

bb. Abrasion-Resistant Urethane Coatings (1)

Research to develop environmentally safe high solids, high-build, abrasion-resistant urethane coating for metallic substrates subjected to submersion.

cc. Innovative Methods for Field-Expedient Waste Disposal (1)

Health and hygiene concerns in the field require a totally new concept or innovation for human waste disposal.

dd. Recycling System for Contaminated Fire Fighting Foams (1)

The design of a recycling system would reduce material costs and reduce water treatment costs.

ee. Handheld Short-Pulse Radar (2)

There is a need for a short-pulse radar system to measure ice thickness. The system must be small, lightweight, easy to operate, and produce a hard copy display.

ff. Radiosonde Balloon Ice Detector (2)

A "throw-away" ice detector is desired for use on radiosonde balloons.

gg. Synchronous Video Recorder (1)

Develop a video recorder capable of changing speed of recording with ability to synchronize with vehicle speed to maintain a constant number of frames for a given traveled distance.

hh. Shock Isolation Equipment (1)

New concepts in shock isolation of equipment. Concepts should include use of new materials or design linkages for application to a wide range of equipment

from computers to equipment containing structures to resist seismic and/or nuclear ground shock.

ii. Mine/Countermine System Analysis (3)

Determine performance characteristics required by airborne sensor(s) for mine detection in specific geographic areas and to develop interactive image processing hardware/software capable of detecting surface and/or buried mines in a homogenous or heterogeneous environment.

jj. Field-Portable Probe or Similar Device for Measuring Soil Moisture Tension (3)

A need exists for a simple and portable device that can be used to sample soil moisture and soil temperature characteristics.

kk. Gyrocompass with Reduced Susceptibility to Shock, Vibration, and Motion (3)

The accuracy of present gyrocompasses is limited primarily by susceptibility to shock, vibration, and motion of the vehicle or weapon. It is desired that the gyro provide an accuracy of 0.5 mil (1.69 minutes of arc) or better when operated in Army tactical vehicles and large caliber weapons while firing.

ll. Multicolor Software Display (3)

There is a need for a large-scale, high-resolution multicolor software display to proof and display maps and charts.

mm. Analytical Study of Soil Pore Pressure Response Under Dynamic Loadings (4)

Measurement response time of pore pressure is a function of a number of soil properties and travel paths of the fluid pulse to the measurement transducers. Given the necessary test boundary conditions, an analytical study is required to identify and quantify those variables affecting the measured response.

nn. Development of Dynamic Airblast Gage for 80,000 psi Explosive Environment (4)

The intended use for the gage is to measure airblast and impulse (i.e., actual impulse per unit area or the time integral of the airblast) from explosive detonations.

oo. Development of a Deflection Measurement System to Operate Under Dynamic High-Pressure Loadings (4)

There is a requirement to make high-resolution measurements of soil deflection under extremely fast (100 sec) transient loadings. Because of the constraints of the experiment, the noncontracting type of measurement must be made within a pressure environment of up to 1-½ kbar.

pp. Materials Resistive to Chemical Warfare (CW) Agents and Decontamination Solutions (11)

A variety of rubbers, neoprene, and plastics appear to be adversely affected by decontamination solutions/procedures after contamination by CW agents. A need exists to derive new/substitute materials for those traditionally used in combat vehicles and which also exhibit either improved resistive or survivable characteristics to the vehicle/CW environments.

qq. Lubricants Resistive to Chemical Warfare (CW) Agents and Decontamination Solutions (6)

Lubricants currently employed by military ground vehicles appear to be susceptable to absorption of CW agents and subsequent dissolving by D8-2 decontamination solution. A resistive substitute lubricant/technique satisfying CW and all other standard mllitary requirements could help resolve the problem.

rr. Attenuation of Noise Sources from Various Components Used in Combat Vehicles (11)

A variety of electrical/hydraulic motors, pumps, fans, and blowers employed within combat vehicle crew compartments contributes to unacceptable noise impositions on crew members. Acceptable methods of acoustic control/reduction for these kinds of components would assist in resolution of the problem.

8. Ballistic Missile Defense Systems (All paragraph 8 topics submit to 18)

a. Software Development Technology - Tools and techniques to improve the ability to produce high-quality software systems in a rapid manner.

b. Software Quality Assurance - Research in tools and techniques designed to allow the quality of software to be effectively assessed through computer-aided support.

c. Distributed Computing Development - Development of tools and techniques designed to aid in the ability to develop distributed computer systems for a real-time environment. Includes work in distributed languages, data bases, and control.

d. High-Repeating-Rate Explosive Flux Generators - New concepts for accelerating projectiles, such as electromagnetic guns, provide novel, reliable, cost-effective potential for nonnuclear kill BMD systems. In order to exploit electromagnetic guns for BMD applications, very large energy levels that can be pulsed repeatly many times a second must be available at relatively low cost.

e. Novel Control Mechanisms for the In-flight, Accurate Guidance of Small, High Velocity Projectiles - For a highly reliable utilization of BMD by projectile impact, where all of the propulsive energy is provided to the projectile at the instant of launch, mechanisms for continuous guidance and control on board the projectile would greatly enhance its effective arrival at the required point of impact. Very high projectile velocity requirements along with volume, weight, configuration, and cost-constrained projectiles establish the major difficulties in this area.

f. Damping and Control of Stress Peaks in BMD Interceptor Materials - Worst-case shock and thermal loads that dicate minimum BMD interceptor materials requirements inflict severe penalties on optimizing interceptor performance

and cost. Novel techniques such as control of material porosity at expected stress peak sites could reduce size, weight, and the high cost of developing new, exotic materials for such purposes.

g. Millimeter Wave Technology - Study the feasibility of adding MMW radar to an optical aircraft which could add accurate range measurements to targets detected optically and also have the capability of performing some of the discrimination tasks from the aircraft.

h. Submillimeter (3-114) Wave Agile Beam Steering - Techniques for a rapidly steered antenna apertures 2.30cm for moderate power coherent laser beam.

i. 95 GHz Agile Beam Antenna - Techniques for rapidly steering radar antennas comparable to phased-array radars.

j. Optical Signature Simulator - A test set for generating and evaluating performance comparable to optical sensors.

k. Flash Annealing of Ion-Implanted Doping Profiles - The evaluation of a process for GaAs device annealing which circumvents the problems associated with the current high-temperature annealing approach.

9. Other Topics of Special Interest

This topic seeks to promote innovative solutions to scientific and technical problems not specifically covered in the Thrust Areas above, but are of interest to the special mission that the Army performs.

a. Electrically Passive Flight Control System Sensor (13)

As automatic flight control functions such as airspeed hold, altitude hold, etc., become more important to both mission success and flight safety, some means of sensing aircraft state parameters via electrically passive optics becomes highly desirable. This would provide increased assurance that improved helicopter handling qualities would be maintalned in a severe combat environment.

b. Load-Attenuating Seat Cushion (13)

Develop a seat cushion of minimum thickness that gives both maximum comfort and minimum dynamic overshoot for crashworthiness.

c. G Indicator (13)

Develop a "paint," thin material, etc., that can be simply attached to a panel in an aircraft structure, that in the event of a crash records the maximum acceleration in the area to which it is affixed. The material must be lightweight, small, and inexpensive to buy and install.

d. Hard Coatings for Optical Systems (7)

Broadband sensors require hard, erosion-resistant coatings, which are transparent from ultraviolet, through the visible, and well into the infrared radiation wavelengths. New concepts for such coatings compatible with state-

of-the-art optical materials are desired.

e. High-Power Silicon Transistors (15) - Need for high-power solid-state devices in the 100-1000 MHz range. Desirable performance of 150-300w cw with 6-10dB gain over bandwidths of up 400 MHz. Efficiency of 50 percent or better is desired. High operating voltage is considered a positive asset.

f. Processing of Microwave and Millimeter Devices (15) - Processing of microwave and millimeter devices by molecular beam epitaxy and metal organic chemical vapor deposition into microwave and millimeter wave devices such as sources, mixers, and control devices.

g. Image Line Monopulse Antennas (15) - Develop monopulse front ends using image line technology to be used in millimeter wave seekers.

h. Positive Plate Materials (15) - Synthesize small amounts of new anode catalysts for rechargeable lithium batteries. Intercalates wlll be described in terms of chemical content, structure, etc., in quantities of 100 grams each.

i. Electron Beam Resists (15) - Conception, fabrication, development, and testing of extremely sensitive (few micron c/cn squared) electron beam resists.

j. Supermatrix Structures (15) - Conception and development of ultrasub-micron lithographic feature capability for quantum-well supermatrix structures.

k. Ferrite Films (15) - Synthesis and characterization of GHz narrow ferrimagnetic resonance linewidth (less than 40 oersted) hexagonal ferrite films for 95GHz resonators.

l. Displays (15) - R&D ideas and approaches to solving problems of highspeed display subsystem architecture including interactive computer graphics techniques: Maximum display information transfer including use of color and other contrast-enhancing techniques and application of artificial intelligence for display/computer/human interaction.

m. VLSI Interconnects (15) - R&D ideas and approaches to solve VLSI interconnect problems such as maintaining connectivity over steps and achieving multilevel metal interconnects.

n. Packaging (15) - Ideas and approaches to solve microelectronic packaging such as mounting of chip carriers (greater than 200 leads, low-k "mother" board materials for high-speed circuits, and a controllable (during manufacture) coefficient of thermal expansion to match "mother" boards to chip carriers.

o. Test Software (15) - Ideas and approaches to the generation of micro-circuit test patterns in use throughout the Government and industry.

p. Nonreciprocal Near-Millimeter Wave (94,140,220GHz) Passive Devices Research (15) - Innovative nonreciprocal passive devices are needed for future near-millimeter wave radar, fuze, guidance, and communications systems. These devices are needed to perform the standard microwave functions of modulation, phase shift, isolation, limiting, duplexing, and filtering. However, standard microwave design techniques for these devices produce poor performance.

Innovative new design principles, materials, and techniques including new transmission line media other than waveguide are needed to achieve high performance at low cost.

q. Near-Millimeter Component Calibration (15) - Program to calibrate and measure accuracy of performance for passive, near-millimeter wave componetry is needed. This program includes such devices as attenuators, frequency meters, waveguide transition, power meters, etc. Diagnostics capability to span the spectral region of 90-250GHz would be required.

r. Sealed Lead Acid Storage Battery (15) - Develop activated lead acid storage battery plates with a minimum of 80-percent charge retention capability after storage in excess of 24 months. Design of plates and the ultimate cells shall be applicable to a military battery configuration in a permanently sealed battery design.

s. Microprocessor-Based Energy Analysis Programs (1)

Simple energy analysis computer programs are needed to evaluate alternate design options for new construction and evaluation of retrofit alternatives for existing buildings.

t. Technologies for Dianosing Building Energy Inefficiencies (1)

Diagnostic techniques are needed by which a building can be evaluated to pinpoint specific retrofit opportunities.

u. Automatic Diagnostic Equipment (1)

Methods are needed for providing diagnostic data and real-time information on duty cycles of electric power generating and energy-using equipment to predict maintenance requirements, define mission profiles, and validate equipment sizing.

v. Artificial Intelligence for Building Design (1)

Develop artifical intelligence applications for use in automated design and operation of military facilities.

w. Alternate Fuels for Facilities (1)

Simple, low-cost methods for converting alternate fuels to heat, cooling and electric power for Army facilities are needed. Methods for cost-effective fuel utilization in equipment sized for individual buildings to a group of buildings (6 to 10) are to be investigated.

x. Ice Detector for Structual Applications (2)

A need exists for an ice detector deployable as part of standard meteorological packages. This detector should be low power, low cost, and give verifiable output that can be used to extrapolate up to design loads for towers, communication dishes, powerlines, and the like.

y. Natural Language Query for Building Design (1)

Natural language query procedures need to be devised to provide automated building design system access by architects and engineers. This will eliminate the intensive training ordinarily required for accessing automated building design.

z. Expert System for Engineering Deficiencies (1)

A method is needed which links historical engineering design and construction deficiencies wlth planned Army construction. The idea is to forecast potentially repeatable problems which can occur in planned projects and alert designers and constructors in advance.

aa. Paint Remover (1)

Research to develop an environmentally safe, low-cost, rapid technique for removing multiple layers of existing paint from wood substrates without damaging the wood.

bb. Pipe Repair System (1)

Research to develop and demonstrate low-cost, rapid linking systems to repair and upgrade existing in-place pipe networks.

cc. Leak Detection Device (1)

Research to develop a leak detection/location device for low-pressure water and other liquid distribution systems.

dd. Underground Construction (1)

New concepts in underground construction of large facilities. Concepts should be aimed at providing low-cost hardened structures.

ee. Gas/Particulate Interfaces of Hexachloroethane Training Smokes (1)

Hexachloroethane smoke consists of submicron particles of chlorides of Zn, Cd and Pb. Define the physical chemistry of the gas/particulate interaction by determining qualitatively and quantitatively the gas phase compounds that are attached to the chloride particles, and whether this changes with particle size/growth.

ff. Soil Analysis of Hexachloroethane Smokes Residues (1)

Characterize and quantify the level of cadmium, zinc, lead, arsenic, hexachlorobenzene, hexachloroethane, and perchloroethane in control and test soils on Army training areas at the surface down to 10cm in depth.

gg. Frost Heave Model Improvement (2)

Develop relationships for pore water pressures (suctions) versus moisture content and unsaturated hydraulic conductivity versus pore water pressure or moisture content.

hh. Remote Sounding System for Subsurface Detection (2)

There is need for a remote sounding system capable of detecting cavities under pavements. Current systems do not allow for rapid survey of large pavement area.

D.2 NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM
Submitting Proposals on Navy Topics

Phase I proposal (10 copies) should be addressed to:

Topics #1 through #74

Headquarters, Naval Sea Systems Command
Department of the Navy
Washington, DC 20362
Attn: Code: 003
SBIR Program

Topics #75 through #94

Headquarters, Naval Electronic Systems Command
Department of the Navy
Washington, DC 20360
Attn: Code: 00K
SBIR Program

Topics #95 through #114

Headquarters, Naval Air Systems Command
Department of the Navy
Washington, DC 20361
Attn: Code: Air 303
SBIR Program

Topics #115 through #124

Office of Naval Research
800 North Quincy Street
Arlington, VA 22217
Attn: Code 400
SBIR Program

Topics #125 through #130

Director, Development Center
Marine Corps Development and Education Command
Quantico, VA 22134
Attn: Legal Counsel
SBIR Program

Topic # 131

Joint Cruise Missiles Project Office
Director of Contracts (JCM-28)(SBIR Program)
Washington, D.C. 20360

1. TITLE: Architecture and Tools for Integration of Office Automation and Data Processing

CATEGORY: Exploratory Development

DESCRIPTION: The development and integration of major information systems remains a difficult problem. New challenges are being presented by the need to couple information systems with modern office automation technologies. Although local area networks can provide communications level support, applications definition, development and integration are still key obstacles. Recently, new concepts in systems architecture have been emerging. These concepts in systems architecture have been emerging. These concepts involve placing specialized functions in several processors for multi-computer/multi-user support. As an example, hardware-based data base machines are now being used to provide data base services to computers and users in a network environment. This frees resources on each computer in the system for applications efficiency. A further example of offloading intelligence is the development of intelligent work stations based on powerful microprocessors. Also recently prototype systems have been developed which can automatically produce programs for information systems, without actual programming, by entering system specifications. These developments suggest new approaches to requirements for integrated data processing/office automation, appropriate architectures can be developed and prototyped. These architectures would contain system development tools as integral components.

System developments based on architectures which provide functional and development tools would proceed with greater possibility of success, should have low maintenance costs, and should be open to integration of new applications. These benefits would improve the effectiveness and economy of information/office systems.

2. TITLE: Detection/Neutralization of Buried Mines

CATEGORY: Exploratory Development

DESCRIPTION: Mines buried in the sea bottom are difficult (often impossible) to detect and pose a significant threat to our mine countermeasures operating units. Various means must be investigated to provide a reliable method to determine a mine's presence and subsequent high rate of mine neutralization. The ability to detect and classify objects buried in the sea bottom will greatly enhance mine clearance/neutralization efforts by our countermeasure forces. Clearance ratio for individual MCM platforms will be increased, the complexity of the mine clearance problem will be reduced, optimum allocation of critical resources (between minesweeping and minehunting) can be made, and port breakout concepts can be solidified.

3. TITLE: Non-Jammable Local Precise Navigation for MCM Operations

CATEGORY: Exploratory Development

DESCRIPTION: Navigation aids are required to allow our MCM forces to transit known and suspected minefields in a precise manner and provide positive open sea lanes and gates through which friendly forces may pass. The ability to precisely neutralize specific/selected water areas will reduce the number of

occasions and locations where dedicated MCM forces are required to assure safe passage of our combatants and support vessels. High rate clearance operations will be realized since valuable station/operating time will not be required for repetitious passes to assure navigation error has been compensated for.

4. TITLE: Shipboard Non-Tactical ADP Program Applications of the Future

CATEGORY: Exploratory Development

DESCRIPTION: The Navy is currently in the process of automating shipboard logistics functions under the auspices of the Shipboard Non-tactical ADP Program (SNAP). However, because of the rapidly changing and improving technology of automated information processing (including miniaturization of hardware, telecommunications, software and data base management advances), the time is now to begin developing and optimizing follow-on integrated systems of the future. Ongoing development of logistics systems, employing state-of-the-art automated information system (AIS) technology that is in pace with automation of the tactical community, is essential to ensuring the optional readiness of the Fleet. Reduced manning profiles of our newer ships demand that support functions be conducted as efficiently as possible with minimal manual intervention.

5. TITLE: Diver Display

CATEGORY: Exploratory Development

DESCRIPTION: Diver Head Mounted visual display for object location in turbid or dark waters - new technology, though minimum investigation has been conducted. Divers are currently restricted by visual limitations and have difficulty in deploying from their underwater platform/vehicle for an appreciable distance and be able to return with surety.

6. TITLE: Alternatives to Organometallic Antifouling Paints

CATEGORY: Exploratory Development

DESCRIPTION: Organometallic antifouling paint development (e.g., organotin, organolead, organoarsenic, etc.) has been the dominant thrust of antifouling paint research since the mid-1960's. This emphasis has included virtually no research into methods of improving the presently used cuprous oxide based paints or the development of non-metallic (or non-organometallic) paints. As a consequence the performance obtained from copper based antifouling paints has decreased from that obtained earlier. Increasingly stringent industrial safety and environmental regulations are restricting the use of organometallic based paints with the result that the Navy now has poorer quality antifouling paint performance that it had prior to recent paint developments. Should have increased ship performance, achievement of long-drydocking cycles, reduced fuel consumption, and reduced costs associated with the use of antifouling paints by using safer toxicants.

7. TITLE: Fire Retardant and Protective Coatings

CATEGORY: Exploratory Development

DESCRIPTION: Some materials aboard ship are degraded by heat and/or fire. These materials are plastic, insulating foam and aluminum. Current Navy coatings will not protect these materials in a full scale fire situation. Benefits derived from these materials will relate directly to ship survivability and personnel safety. These new materials will be developed to keep a ship in service in the event of serious fire.

8. TITLE: Acoustical Flexible Anti-Sweat Foam Insultation

CATEGORY: Exploratory Development

DESCRIPTION: There is a need to develop an acoustical insulation for use in machinery spaces and duct work which does not absorb oil or moisture. The material presently used for this application is fibrous glass with a vapor barrier. If the vapor barrier is breached, the glass soaks up oil or moisture causing it to become a fire hazard or not perform its insulation job properly. The use of an accoustic insulation which does not absorb oil or moisture will greatly reduce the fire hazard in machinery spaces and reduce the corrosion problem associated with duct work.

9. TITLE: Light Weight Fire Insulation

CATEGORY: Exploratory Development

DESCRIPTION: Presently the Navy is using ceramic insulation to protect aluminum structures and Kevlar ballistic armor from fire; aluminum will melt and lose structural integrity and Kevlar armor will burn and liberate toxic gases which will inhibit fire fighting. The present material is heavy and adds substantial weight to the ship. New methods of manufacturing and new materials which are lighter in weight should be developed. Topside weight will be saved while the ship's structure will be able to better withstand the problem a fire presents and allow the ship to survive what might be a catastrophic fire.

10. TITLE: Fume Tight Door Materials

CATEGORY: Advanced Development

DESCRIPTION: Adequate seal on quick acting door that will provide a fume tight barrier - solution requires development of gasketing materials, gasket installation, door/hinge design along with interface/structure of bulkhead that can give better than 75% efficiency and will last. Improved safety and habitability - prevents the ingress of noxious fumes into crew living/messing areas.

11. TITLE: Composite Structures and Containment Vessels

CATEGORY: Advanced Development

DESCRIPTION: Develop and utilization of light weight, inexpensive, seawater resistant materials to be used as strength members and containment vessels of various shapes and sizes. Light weight and inexpensive materials will result.

12. TITLE: Radar Cross Section Coatings

CATEGORY: Exploratory Development

DESCRIPTION: Combatant craft are readily detected by Radar in hostile areas. Based on recent investigations it has been shown that operational effectiveness can be improved with usage of Radar Cross Section (RCS) camouflage. SEAFOX applications have indicated that the RCS reduction can be made with a minimum amount of program impact. To utilize RCS to the maximum we will require a light inexpensive, simple to manufacture Radar Absorptive Material (RAM). RAM should be suitable to marine environment, readily maintainable with no change in craft configuration. Much work has been accomplished in this area by NSWC, Dahlgren; NWSC, Crane; and NRL. Specific benefits accrued would be realized in the crafts improved operational effectiveness and survivability.

13. TITLE: MW Tactical Theory and Planning Methodology

CATEGORY: Exploratory Development

DESCRIPTION: Development of minefield and mine countermeasure theory and related analytical models which can treat the entire stockpile-to-target sequence and be used to evaluate complex multiport and campaign level scenarios. Near term application of this improved methodology will allow more realistic predictions of the effectiveness of various minefield designs; permit more efficient utilization of available mining assets; provide a capability to accurately determine stockpile requirements; and realistically compare the attributes of new mine design concepts.

14. TITLE: Shipboard IC Circuit to "Net" Administrative Computers

CATEGORY: Exploratory Development

DESCRIPTION: Development of a Shipboard Interior Communications (IC) circuit for use by administrative computers to transmit information for management of ship functions, perform equipment maintenance, determine supply support availability. This will: (a) enhance use of administrative computers; (b) improve maintenance actions; (c) reduce maintenance manhours; and (d) reduce equipment downtime.

15. TITLE: Acoustic Lens

CATEGORY: Exploratory Development

DESCRIPTION: Develop materials which can shape/direct acoustic energy with minimal loss of power to eliminate side lobes. Weapon systems and platforms would be more effective and have a better chance for survival. Fleet Operations should be improved. Money, manpower and time will not be directly saved. The systems using this improved technology will become more effective.

16. TITLE: Underwater Magnetometer/Metal Detector

CATEGORY: Advanced Development

DESCRIPTION: During deep submergence search operations using STSS or DSV's items of interest are not detected because of submergence in soft bottoms or due to a covering of silt, sand, etc. A metal detector/magnetometer which

could be attached to the search vehicle and which would be operable to 20,000 feet is needed. This will increase the effectiveness of search missions decreasing required search time.

17. TITLE: Improved Thermal and Acoustical Insulating Materials or Techniques

CATEGORY: Exploratory Development

DESCRIPTION: Improve Thermal/Acoustical Insulating Materials/Techniques Survey materials and techniques for insulating combatant craft thermally and acoustically. By comparative test data determine materials/techniques to be specified in new construction which will use improved insulating materials, lighter in weight, easier to apply, less costly and less fire risk. (1) List thermal and acoustical insulation materials/techniques currently used aboard U.S. Navy ships. (2) Survey the insulation materials/techniques currently used aboard commercial ships and foreign Navy ships, where possible. (3) Survey insulation for land based construction. (4) Perform lab/craft tests where needed. The goal is improved insulating materials, lighter in weight, easier to apply, less costly and less fire risk.

18. TITLE: Feasibility Study on Use of Inflatable Boats as Target Drones

CATEGORY: Advanced Development

DESCRIPTION: The present Target Drones (18' TD) and (54' TD) are designed to be "expendable" but they are not cheap to buy. An inflatable boat with outboard motor can reach comparable speeds, carry same loads at much less cost to the Navy. An 18' Inflatable Boat can do 50 mph (or better) and can cost under $5,000.00 each. A rigid metal or wood floor board can hold the same equipment at considerable savings.

19. TITLE: Install a remote indicating fire and flooding alarm system on boats/craft

CATEGORY: Advanced Development

DESCRIPTION: To enhance the safety of craft left unattended in the water by decreasing the possibility of loss from a fire or flooding hazard through installation of a remote indicating alarm system. This system will provide the user activity with a means of remote indication of fire or flooding onboard unattended craft and facilitate the dispatch of emergency services. A system consists of a central monitor, repeater(s), transmitter(s), and sensor(s). Operation is via long range telemetry, no wire is required.

20. TITLE: Need 6-8 man capacity inflatable lifeboat

CATEGORY: Advanced Development

DESCRIPTION: There is a need for a small, (6-8 man capacity) inflatable liferaft for the smaller combatant craft. This raft would be capable of inflating in cold temperatures, be vulcanized, inherently stable in sea states of 4 or 5. Present liferafts are the 15, and 25 man size; too heavy for smaller craft. New technology is not needed since the preliminary design parameters have been explored in the recent development of the Helicopter Extractable Cold Weather

Liferaft. The survival of combatant craft crewmen will have a liferaft for use in an emergency that can be depended upon in areas of cold weather operations.

21. TITLE: Decoys for Combatant Craft

CATEGORY: Exploratory Development

DESCRIPTION: Combatant craft need inflatable decoys that have the heat source, sound, and radar signatures to confuse incoming missiles. These could be stowed aboard the craft and deployed near the mother craft when needed. The benefits to the Navy would be the preservation of Fleet Combatant Craft and their crews. Each combatant craft will immediately become more effective.

22. TITLE: Shipboard Carbon Dioxide Laser

CATEGORY: Advanced Development

DESCRIPTION: Battle Group anti-air warfare (AAW) capability would be greatly enhanced by the availability of a medium power carbon dioxide laser afloat. The laser would be used against anti-ship cruise missiles. Technology exists to produce such a carbon dioxide (CO_2) laser system. Experimental data demonstrates that an operationally useful damage mechanism would be attained. This effort would begin with a detailed design. Phase II would be manufacture of an advanced development model.

23. TITLE: Enhanced Chemical Laser Efficiency

CATEGORY: Exploratory Development

DESCRIPTION: Chemical laser system efficiency could be greatly improved if higher energy density reactants were developed. This effort would begin with screening of reactants suitable for CW chemical laser operation (requirements classified). Initial equilibrium combustion testing and reaction product analysis is desirable. Phase II might entail subscale synthesis of sufficient quantities of candidate reactants for subscale laser tests at a Government-owned facility.

24. TITLE: Optical Coatings for Pulsed Chemical Lasers

CATEGORY: Exploratory Development

DESCRIPTION: High reflectance coatings capable of withstanding high peak and average power levels are required. The contractor should be capable of developing coating materials, designs, and deposition techniques necessary for pulsed chemical laser applications (requirements classified). An initial survey of existing materials and techniques is suggested, followed by screening or development of advanced approaches. The second phase of this SBIR effort would be actual coating of witness samples and survivability.

25. TITLE: Safety Improvements to Lithium-Based Power Sources

CATEGORY: Engineering Development

DESCRIPTION: The Navy has great interest in the increased shelf life and

energy density of lithium-based power sources when compared with conventional units. However, numerous incidents have shown that lithium chemistry includes failure processes that present serious hazards to equipment and personnel. The contractor will evaluate the chemistry and production methods of various commercial lithium-sulfur dioxide or lithium-thionyl chloride cells, and propose a change in the materials, configuration, production process, or quality control that will demonstrably increase safety without significantly decreasing the positive characteristics. The proposal will include a cost and schedule plan, including testing, evaluation, and safety, reliability, and producibility analysis and demonstrations.

26. TITLE: Passive Underwater Target Detecting Devices

CATEGORY: Advanced Development

DESCRIPTION: The most effective naval mines contain a device capable of detecting the location, course, and type of potential underwater or surface target vessels at a distance without generating signals from the mine. The contractor will define an approach based upon proven technology, conduct an analysis to determine the operational characteristics (range, accuracy, noise immunity, power consumption, etc.) of the device, and prepare a development plan describing the cost and schedule for all phases: design, fabrication, test, evaluation, reliability and producibility reviews, production, and logistic support.

27. TITLE: Efficacy of Automatic Stud Welding

CATEGORY: Engineering Development

DESCRIPTION: Determine the limits of surface contamination (e.g., paint, dirt, grease, fouling, water, etc.) for successful stud welds from an automatic production stud welding machine.

28. TITLE: Software Safety Analysis

CATEGORY: Engineering Development

DESCRIPTION: Conduct an independent safety analysis for computer programs associated with nuclear weapons.

29. TITLE: Ship Systems Initiatives, Justifications, and Prioritization

CATEGORY: Exploratory Development

DESCRIPTION: Describe ship systems initiatives, derived from the basic Ship/Systems Initiative Development (SID) Program in sufficient depth to provide:

1. Program managers with data, required performance capabilities, trade-offs, and risks to plan and justify each initiative.

2. Decisionmakers with the above, in a form most useful to show the inter-relationship with existing RDT&E programs, relation to future ship acquisition and for prioritizing the initiatives.

Presently, new R&D efforts are generally product improvements and prioritization is established by best judgment. The SID Program identifies ship system initiatives based on performance shortfalls or inefficiencies. In addition, the SID process identifies alternative solutions to these shortfalls that result in initiatives.

An in-depth analysis of these initiatives is required to determine expected performance capabilities, technology and schedule risks, application/utilization and comparisons and for trade-off with other initiatives or existing R&D programs.

Analyses of requirements are to be performed to determine a method of data presentation necessary to meet objective 2. stated above.

These data would also provide an essential input to the CONFORM, EPA, and specific ship design and acquisition programs.

Phase I effort is to establish a method to conduct the initiatives analyses.

30. TITLE: Anti-Air Missile Warhead Catalog

CATEGORY: Exploratory Development

DESCRIPTION: Prepare a catalog of U.S. non-nuclear Anti-Air Missile warhead investigations initiated or developed over the past twenty (20) years. The investigations considered are to include but not be limited to production or operational items. Also to be included are those technology designs, concepts, and studies that were initiated but terminated prior to successful completion.

Information to be compiled should include but not be limited to:

- o name or title
- o place and period of investigation/development
- o present status
- o physical characteristics
- o drawing/sketch/photograph
- o if terminated - reason for termination
- o references/sources of information

31. TITLE: Solid Fuel Ramjet - Fuels and Combustors

CATEGORY: Exploratory Development

DESCRIPTION: Efforts are needed in several areas: (a) Alternate fuels should be evaluated which have attractive potential performance characteristics for both volume limited and weight limited applications. Propose research effort to evaluate the practicability of efficient combustion of these fuels. (b) Additional combustion characterization is needed (grain regression rate versus pressure, etc.) for existing solid fuels and grain designs. Opportunities exist for both analytical and experimental contributions in this area. (c) Innovative ideas are needed for practical methods of fuel flow control during combustion, and/or practical methods of vehicle speed control to permit optimum performance.

32. TITLE: Hypersonic Air Breathing Engine Fuel Control

CATEGORY: Exploratory Development

DESCRIPTION: Innovative conceptual designs are needed for low volume, light weight, and simple techniques for supplying and controlling liquid fuel flows for airbreathing engines which operate in the Mach 5-10 regime. Earlier methods involving air-turbine driven pumping systems are complicated by the high enthalpy of engine bleed air, and new systems need to be proposed and evaluated.

33. TITLE: Hypersonic Air Breathing Engine Inlet Conceptual Design and Analysis

CATEGORY: Exploratory Development

DESCRIPTION: (a) Innovative conceptual designs are needed for air inlets for air-breathing engines which operate in the Mach 5-10 regime. Emphasis should be placed on high inlet efficiency, high air-capture, low drag and favorable operation at angle-of-attack. (b) Improved analytical techniques are needed in the computational fluid dynamics (CFD) area for calculating both external and internally ducted flow properties for hypersonic air inlets accounting for both inviscid and viscous effects. These techniques would be applied to the evaluation of potential performance of new innovative inlet designs.

34. TITLE: Safe/Economical Processes for Rocket and Gun Propellant Manufacture

CATEGORY: Exploratory Development

DESCRIPTION: The use of highly energetic ingredients, such as as the cyclic nitramines, RDX and HMS, are becoming increasingly necessary to meet the performance requirements of gun and rocket systems. Although these propellants are being processed in currently available facilities, the Navy desires to investigate alternate methods for their manufacture which would be less hazardous and more economical. Topics to be addressed would include the following:

(a) oxidizer preparation to achieve required particle size and particle size distribution

(b) fuel preparation and analyses

(c) propellant ingredient blending and mixing

(d) propellant curing

(e) continuous versus batch process

35. TITLE: Thrust Vector Control Devices for 13.5-Inch Rocket Motor

CATEGORY: Advanced Development

DESCRIPTION: Develop a compact long duration Thrust Vector Control (TVC) device suitable for use in the Vertical Launch System (VLS). This VLS places limitations on the initial thrust levels of boosters but once out of the launcher the

TVC device must have the capability of rapidly turning the missile to the desired heading thus avoiding the waste of propulsion impulse.

A considerable amount of Research & Development Effort has been conducted and has provided improved movable nozzle TVC and jet vane TVC devices which provide good performance. Application of this technology to new missile systems requires survival for very long times with high performance propellants. High slew rates, omni axis capability and roll control are required.

36. TITLE: Burning Rate Modifier for Nitramine Propellants

CATEGORY: Exploratory Development

DESCRIPTION: Develop materials that have a modifying effect on the ballistics of nitramine-containing propellants. Composite type propellants presently in use contain ammonium perchlorate which can be ground to various degrees of fineness to tailor the burning rate of the resulting propellant. Such grinding of nitramines has no effect on burning rate and so catalysts and additives must be used.

The modifiers must be compatible with other ingredients in the propellant, have long term stability at extremes of temperature and be able to modify burning rate, pressure exponent, and temperature coefficient of nitramine-containing propellants.

37. TITLE: Determination of High Temperature Strength of Rocket Motor Case Materials

CATEGORY: Exploratory Development

DESCRIPTION: Perform tensile tests on samples of rocket motor case materials (for example, 4130 and 7075-T6 aluminum) at temperature approaching the melting point to simulate direct exposure to rocket exhaust gas. Determine yield and ultimate strengths as a function of temperature beyond the range published in MIL Handbook 5.

38. TITLE: Thin Wall, Non-Ferrous Propellant Tube for Volume Limited Rocket Motor Applications

CATEGORY: Exploratory Development

DESCRIPTION: Develop and evaluate candidate materials as suitable propellant tubes to be used in cartridge loaded rocket motor applications. Thin wall materials allow higher performance to be incorporated into volume limited applications while maintaining reworkable hardware. Materials to be evaluated for bond strength, axial and longitudinal loads, impact, resistance, porosity, dimensional stability and heat resistance.

39. TITLE: Cast-in-Place Nozzle Inhibitor for Flow Turning Applications

CATEGORY: Exploratory Development

DESCRIPTION: Develop and evaluate formable in-place nozzle inhibiting

material(s) for rocket motor applications in which the thrust vector is not axial to the motor axis. Some rocket motor applications require turning the exhaust flow prior to expulsion from the nozzle. This application will develop materials to allow flow turning without nozzle/case damage.

40. TITLE: Emission Strategies and Operations in Modern Naval Combat Systems

CATEGORY: Advanced Development

DESCRIPTION: An important factor in naval warfare is the use by an adversary of one's own signals (emissions) in both pre-battle intelligence and more immediate targeting and homing during the battle. To counter this use, it is not always appropriate, obviously, to cease operating one's own electromagnetic (and other) radiating equipment. Rather, with the very versatile and computer controlled systems now entering the fleet, more imaginative strategies for radar and radio use, based on total data-base inference and "gather data as needed" logic, are possible, strategies that include cover and deception as well.

Proposals are requested for a six-month study of such strategies, in a context of the modern battle force. The early work would establish example systems and a reasonable scenario such that a description of such control strategies may be described and illustrated in the usual gain, loss and risk factors common to game theory. The effort will produce a report of less than 100 pages which describes results and proposes effort to follow of a more rigorous derivation of such strategies (with modeling to substantiate their worth) and algorithms upon which such strategies can be based.

Firms responding should have familiarity with naval surface warfare and systems and be skilled in classical stochastic analysis, which capabilities and a description of the general approach to best use of the short study time the proposal should make clear.

41. TITLE: Tracking Algorithms - Exploitation of Total Inference Base In Surface Ships

CATEGORY: Advanced Development

DESCRIPTION: The work described here (a six month, one to two man effort) is in the area of multi-sensor target (aircraft generally) tracking. The Navy has made considerable advances in the last several years in the area of integrated tracking wherein several sensors (radars and ESM, for example) contribute individual data ("contacts") to a single track estimate. The purpose of this study is to expand this approach by 1) using still other data available in the earliest possible steps of track establishment (a priori information; information from communications with other similar ships; the often-discarded doppler information from one's own anti-clutter radar) and 2) taking advantage of control processes now available in computer-controlled systems, particularly in phased array radar. The effort will produce a report with preliminary but quantitative results, i.e., some algorithm based on dissimilar source data (contacts) in which bounds or weights are functions of other data (a priori; doppler info ...) not normally used. The report will describe follow-on effort of one to two years' duration in which more rigorous modeling would be done and experiments performed.

Firms submitting proposals must have familiarity with exponential track filtering and association processes and the general Navy operational environment. The proposals must make this background clear, and provide a general scoping and scheduling strategy for best use of the six-month period.

42. TITLE: Analysis of Peculiar Demands of Interior Communications in USN Surface Combatants

CATEGORY: Advanced Development

DESCRIPTION: The Navy has found it difficult to take advantage of the latest developments (particularly those in the commercial sphere) in communications technology in the interior communications systems aboard ships. The purpose of this six-month effort is to "marry" the Navy's particular needs in combat-system-associated interior communications with the latest of techniques and equipment resources coming from the general community. A rudimentary model of a Navy combat center will be derived, present methods understood for background; a survey of applicable modern techniques in, principally, voice, digitized voice and some data communications shall be peformed to lead to a description of a notional system, and, finally, a treatment of the necessary "militarization" of such a modernized system shall be included. The final report of the above analysis shall include a proposal for a one-to-two year effort of more thorough study and design and advanced development of an experimental and demonstrable sort.

Firms responding should have an understanding of naval interior communication systems and of combat operation, and of the field of communications and modern techniques. The proposal must make that background clear and establish a best use event sequence for the six-month period.

43. TITLE: Application of Modern Materials to Critical Combat System Components

CATEGORY: Engineering Development

DESCRIPTION: Cost, weight and durability of equipment remain matters of great concern to the Navy. Within the last decade advances have been made in light-weight strong materials (specifically in the graphite-epoxy and various metal-matrix types of materials) that may offer some relief in these areas. The purpose of this task is to identify particular components of deployed weapon and sensor systems, to describe the application thereto of appropriate new materials, to describe the nature of the component and its manufacture so constructed, and to appraise the relative benefit in the cost, weight and durability areas. It is expected that electromagnetic components (radio or microwave frequencies), electronic components (cabinets, unit assemblies) or mechanical apparatus (parts of launchers, loaders or handling equipment) would be typical of components to be selected early in the effort. The effort shall produce a report which shall describe the five-to-ten components so studied as they might use the newer materials and the benefits of doing that; the report shall propose a one-to-two year effort to follow in which selected components would be developed in a demonstrable prototype form.

Firms proposing must have experience in military equipment in general, in the rigors of service use, in the technical performance of the components

involved, and in the factory processes involved in manufacture. The proposal must make these qualifications clear and must exhibit a plan to use effectively the "six-month" period.

44. TITLE: Reduction of Manning in USN Shipboard Combat System Operation

CATEGORY: Engineering Development

DESCRIPTION: The Navy has a desire to use its manpower as effectively as possible; considering particularly the high cost of supporting personnel on ships, a reduction in the number of operators necessary in combat system operation is most desirable. The purpose of this task is to present alternatives to the structure of operator roles and the balance between human and computer operations in the modern multi-mission combat information center. The effort will be based on the AEGIS combat system; liaison with the AEGIS project at the beginning of this effort is critical. The report must describe alternatives in the battle organization or in the roles of individuals in the present organization (with concomitant changes in the nature of the automation involved) that have the potential of reducing personnel numbers or grades. The report of findings at the conclusion of this six-month effort must include some flow-charting and "scripting" of the operation in a modest multi-mission operation to illustrate the recommended alternatives and present a proposal for a one or two year follow-on effort to go into the computer programs and system modeling in more detail.

Firms proposing should have experience in Navy combat system operations from an interior point of view and some human engineering and computer systems experience. The proposal should discuss that experience, present a plan for the best use of the six-month period and suggest the nature of the exhibit to be made in the final report of alternatives investigated.

45. TITLE: Skirt Wear, Reduction of, Air Cushion Vehicles

CATEGORY: Advanced Development

DESCRIPTION:

1. Phase 1 of this task is to collect and analyze data to determine the feasibility of reducing air cushion vehicle skirt wear while operating over concrete ramps and pads. It is intended that previous experience with Air Cushion vehicle operations be fully utilized particularly operations in the United Kingdom (military and civil) and at the DTNSRDC Experimental Trials Unit in Panama City, Florida.

2. An output of Phase 1 will include a detailed test plan and procedure for testing skirt material. Actual testing and evaluation of the skirt wear reduction system will be performed in Phase 2 of this task. Samples of skirt materials to be tested will be provided.

3. This task is not related to a specific vehicle; however, some operational parameters, such as relative speeds, will be provided.

46. TITLE: Headspace Controlling Breech for Mann Test Barrels

CATEGORY: Exploratory Development

DESCRIPTION: The Majority of breech systems for small and intermediate caliber Mann barrels do not provide for headspace control in loading the fixed ammunition prior to firing. This failure to control head space result in varying chamber volumes with concomittant variations in breech pressures.

The design and development of a reasonably priced Mann barrel breech would be of benefit in gun propellant R&D in that a variable condition can be controlled.

47. TITLE: Design Methods for Ships Structural Response to Extreme Seaway Loadings

CATEGORY: Advanced Development

DESCRIPTION: The objective is to develop an analytical capability for predicting the structure responses of ships in a seaway, capable of application in the early phases of ship design. Until the advent of computer analysis, three dimensional model tests in a seakeeping basin and full scale trials in oblique seas were the only sources for data on ship structural response in a 3-D seaway. The time and cost required for such tests, however, make them impractical for direct application in the design process where the impact of a large number of ship parameters on structural response is desired. The continuing advances in computer technology, however, is now making possible the development of sophisticated, yet practical (from a time and cost viewpoint) computer codes for predicting the behavior of ship hulls operating in realistic seaways. Such codes are capable of describing hull structural response due to wave action, slamming (both bow flare and bottom), as well as that due to other types of impact load. ROSAS 3 has been written to predict these structural responses. Under this task the 3-D version of ROSAS will be fully documented and verified with examples. An interface with the design program SHCP will be made, and documented, allowing the structural designer to dynamically calculate ship response to extreme wave loadings.

48. TITLE: Ship Structural Details Using Angles and Channels

CATEGORY: Advanced Development

DESCRIPTION: The objective is to produce a Structural Detail Design Handbook for stiffeners of angle and channel cross-section. Structural detail design has been a blend of experience, science and art. Consequently, detail design is different in each shipyard. A military handbook is needed to standardize this design practice. This study will include: (a) collect structural detail data; (b) develop details screening process; (c) select appropriate details; (d) derive details design sizing algorithms; (e) conduct sensitivity studies; (f) prepare Detail Design Handbook.

49. TITLE: Extreme Seaway Loads Characterization for Ship Structures

CATEGORY: Exploratory Development

DESCRIPTION: Develop the half cycle (HACYM) method of random data analysis as a means of identifying and characterizing extreme waves. Extreme wave data

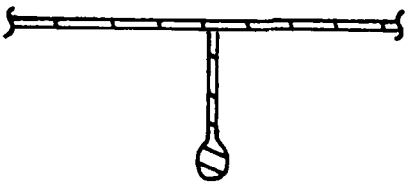
must be acquired and analyzed from Navy and commercial ship heavy weather damage information to identify critical loading problems. Correlate these synoptic conditions with occurrences of extreme wave loadings. Characterize wave impact loadings, categorize these loadings, and establish design classes for structure subject to extreme seaway loadings. Navy ship structural design to withstand both local and overall hull girder loadings is generally empirical in nature and does not result from a rational definition of extreme seaway loadings. As a result, assurance of structural integrity in extreme seaways are implicit rather than explicit under the current state-of-the-art. This tasks is intended to provide those technology developments which will lead to explicit assurances of adequate structural integrity. This will result in improved safety during severe storms and in improved combat readiness after such storms compared to that which can be offered by current design criteria. It will also help to preclude "Class Problems" which have occurred in the past.

50. TITLE: New-Longitudinal Stiffener Configuration

CATEGORY: Exploratory Development

DESCRIPTION: The objective of this proposal is to save ship construction time and cost through simplification of the structural configuration of longitudinal structural members. In portions of ship structure, the flange of a conventional "T" shaped stiffener, can result in difficult fit-up and access for welding. Concentration of this flange greatly improves the welding access and results in easier collar installation.

This proposal recommends investigation of the potential steel mill fabrication cost of the special mini-flange TEE and the shipyard savings to be realized by the use of a mini-flange "T" for longitudinal ship structures. The special mini-flange "T" could look in section like the symmetrical bulb stiffener.



The concept would have great acceptance by shipyards for both steel and aluminum ship structures:

The study shall include:

A. Literature Search
B. Configuration Screening
C. Analysis Tradeoffs
D. Steel Mill/Shipyard Inputs
E. Final Report w/recommendations

51. TITLE: High-Current Circuit Breakers for Naval Shipboard Electric Power Systems

CATEGORY: Advanced Development

DESCRIPTION: Develop and analyze novel design concepts for circuit breakers with interrupting capacity of 200,000 amps for use in 450 volt, 650 Hz electric power distribution systems in Naval Ships.

52. TITLE: Low-Harmonic 400 Hz Line Voltage Regulator for Shipboard Power Systems

CATEGORY: Advanced Development

DESCRIPTION: Develop and analyze new design concepts for line voltage regulators for 400 Hz shipboard electric power systems which are capable of accepting non-linear input without causing harmonics on the power source.

53. TITLE: Reversing Gas Turbine

CATEGORY: Advanced Development

DESCRIPTION:

1. Using advanced technology, the contractor will determine what must be developed and the extent of changes that will be necessary to modify existing gas turbines for direct reversing in the power turbine.

2. The contractor will determine benefits and disadvantages to the Navy with particular emphasis on new ship construction and follow-up operation.

54. TITLE: Non-Magnetic Cast Iron Diesel Engine

CATEGORY: Exploratory Development

DESCRIPTION: The contractor will determine methods that might be employed to economically and with high yield, produce modular cast iron engine blocks for small and medium size Diesel engines.

55. TITLE: Advanced Shafting Technology

CATEGORY: Exploratory Development

DESCRIPTION: The contractor will examine techniques that may be employed to produce low RPM, high torque shafting for Navy ships, subs, and boats. Adaptation of advanced materials (composites, etc.) and manufacturing technqiues will be considered.

56. TITLE: Heat Pipe Application to Gas Turbines

CATEGORY: Exploratory Development

DESCRIPTION: The contractor will investigate possible areas and methods of application of heat pipe technology to gas turbines. The purpose will be to improve the efficiency of the basic, simple cycle engine. Simplicity, reliability, and cost effectiveness will also be considered.

57. TITLE: Market Survey of Developers of Antennas for Portable Ground Telemetry

CATEGORY: Engineering Development

DESCRIPTION: A technology survey of antennas, antenna development, and related research activities having application to performance requirements of AN/SKQ-9 & -10 telemetry system antennas. The SKQ-9 & -10 are mainstay portable shipboard UHF receiving systems for performance data telemetered from in-flight STANDARD Missiles. Each system contains one portable, High-Gain antenna containing both narrow and wide beam automatic changeover features that are mounted on an autotracking pedestal.

58. TITLE: Missile Test Equipment, Low Cost & Simple Maintenance

CATEGORY: Advanced Development

DESCRIPTION: Present automatic test equipment for guided missiles is extremely costly ($4 million) and requires a graduate engineer to maintain it. There is a need to make a concerted examination of integrated circuit and microprocessor technology to missile RF guidance test set requirements. This task shall be to survey and compare the capabilities of current military missile test equipment and their current designs including microprocessor applications. A development plan for comparison of low cost applications by breadboard and critical parameters using current military or suitable commercially available integrated circuit and microprocessor techniques should result.

59. TITLE: Design Concepts for Conventional Warheads for Anti-Air Guided Missiles

CATEGORY: Advanced Development

DESCRIPTION: Increased lethality of conventional anti-air missile warheads is required. The targets are hard, fast, anti-ship missiles and require a fast kill. Very high fragment velocity is required, as is airframe structural load-bearing capability. Desired are: simple case design, ease of manufacture, and a case unit cost below $400. Warhead weights: 50-to-250 pounds, fragment weights: 50-to-1000 grams.

60. TITLE: Effect of Surfactants on Fluid Flow

CATEGORY: Exploratory Development

DESCRIPTION: Recent flow experiments have shown that surfactants when added to water can dramatically change the flow characteristics. The reasons for these changes have not been proven. Different surfactants have produced different flow results.

The purpose of this program is to investigate the surface chemistry effects of surfactants, and water, produce in the laboratory various types of surfactants and characterize their effect on the flow parameters over different surfaces. The contractor should possess a knowledge of surfactants, their effect on surface chemistry and be able to produce small quantities for testing in hydrodynamic facilities. The contractor must also be able to neutralize the surfactant's effects so as not to contaminate the test facilities.

61. TITLE: Tracking Function for AN/SQS-26CX Broadband Passive Sonar

Subsystem

CATEGORY: Engineering Development

DESCRIPTION:

1. Perform study to determine cost-effectiveness of adding a target tracking function to the broadband passive subsystem of the AN/SQS-26 Sonar. Determine optimum passive bearing accuracy for ASW mission of FF 1052 Class ship.

2. Provide report describing details of study conducted and recommendations regarding implementation, if considered cost-effective.

62. TITLE: Target Simulator for Surface Ship Passive Sonar Subsystem

CATEGORY: Engineering Development

DESCRIPTION:

1. Determine most cost-effective method for providing a passive acoustic target simulator for surface ship passive sonars. Simulator shall be embedded in existing sonar system, and shall be capable of providng for passive performance monitoring and shipboard training. Simulator shall be capable of generating a minimum of four (4) acoustic lines.

2. Submit report detailing studies conducted and recommendations for implementation.

63. TITLE: Measurement of Surface Ship Sonar Self-Noise

CATEGORY: Engineering Development

DESCRIPTION:

1. Conduct complete review of techniques used to measure surface ship sonar self-noise. Determine relative accuracy of the various techniques.

2. Based on present state-of-the-art, determine what new techniques could be used to measure surface ship sonar self-noise. Determine relative accuracy of these new techniques.

3. Provide recommendations with backup rationale for a method of measuring surface ship sonar self-noise to obtain maximum accuracy with greatest ease of operation. Trade-offs based on cost-effectiveness shall be included.

4. Submit report describing the effort expended and results obtained under Item 1, 2, and 3 above.

64. TITLE: ALOFTS Test and Evaluation Analysis

CATEGORY: Engineering Development

DESCRIPTION: Demonstration of an Interim Action Low Frequency Towed Sonar

(ALOFTS). ALOFTS is a low frequency (1KC), below layer active sonar to be installed in Variable Depth Sonar (VDS) using the SQR-18 towed array as the receiver.

Tasks include: (1) Review contractor proposal, design, T&E plan; (2) Verify performance predictions, compare validity of other system capabilities; (3) Monitor transducer lake tests, subsystem and system facility tests; (4) After the U.S. Navy performs ship installation and test and evaluation, conduct system analysis trade-offs and assess application of ALOFTS concept for other ship classes and systems.

65. TITLE: In-Water Calibration of Surface Ship Sonars

CATEGORY: Engineering Development

DESCRIPTION: Develop an approach by which a known source level (e.g., AN/WQM-6) in measured environmental conditions may be used to conduct a quick (one day) evaluation of ship self-noise and recognition differential figures, permitting identification of problems or confirmation of sonar status.

66. TITLE: Gearless, Direct Drive, Inertia Sustained Power Unit

CATEGORY: Advanced Development

DESCRIPTION: Design and construct a one-quarter scale model of a gearless, direct drive, inertia sustained power unit for proof of concept verification. The design should be such that, with minimum modification, a full scale prototype could later be constructed as a power drive for Navy positioning systems in gun mounts, weapon launchers, radar antennae, or other applications. This power drive unit would replace current bulky, noisy, expensive, geared power transmission units of limited growth capacity requiring frequent maintenance. Application for patent has been made on the concept which would provide quiet, backlash free, reliable, infinitely variable speed controlled, forward or reverse operation and which would be sustained on significantly lower input power from a prime mover. This concept is also presently being analyzed under an Individual Research project at NUSC.

67. TITLE: Redesign ASROC Launcher MK 112 Missile Restraint Mechanism

CATEGORY: Engineering Development

DESCRIPTION: The existing Restraint Mechanisms were never designed as a dynamic stop. Missiles were initially "jogged" into position and latched into place. Now, with power-driven missile loading systems aboard ships, the existing design does not permit sufficient time to catch the missile lug properly nor can the existing design be redesigned to do so. This project requires innovative design which will provide all of the features requried of a restraint mechanism when used in conjunction with power driven loading systems.

68. TITLE: Lubrication Study Relative to ASROC Launcher MK 112

CATEGORY: Engineering Development

DESCRIPTION: Perform analytical study of lubricants and methods of application

and retention, small scale modeling and testing. Study will provide basis for the redesign/improvement of missile launch systems. Providing state-of-the-art lubricant and methods for reduction/elimination of ship's force lubrication between major overhauls and elimination of lubrication related equipment failure.

69. TITLE: Develop Three Dimensional Finite Element Mesh of SVTT MK 32 Rotating Base

CATEGORY: Engineering Development

DESCRIPTION: Develop a three dimensional finite element mesh of Surface Vessel Torpedo Tube MK 32 Rotating Base. Data file to be compatible with ABAQUS and verified using dynamic loading inputs from existing empirical test data. This effort will be included in a full model of the launcher training assembly. The full model will assist in developing and evaluating the feasibility and practicability of proposed solutions in analyzing potential problem areas resulting from increased launcher weight due to armament, ALWT, and a new quadritube launcher.

70. TITLE: High Speed Surface Ship Torpedo Launch Dynamics Computer Model

CATEGORY: Advanced Development

DESCRIPTION: In veiw of projected surface platform advancements, in terms of speed and maneuverability, and hydrodynamic concerns of advanced torpedo technology, water entry dynamics of surface launched torpedo configurations is becoming increasingly important. Under NUSC Independent Exploratory Development Project A42120, a pneumatic launch computer simulation model was developed and subsequently modified to generate exit velocity and static platform trajectory data for various launcher and torpedo configurations. Extension of this model for evaluation of dynamic platform characteristics is proposed. This would include analysis of aerodynamic effects on the torpedo trajectory and hydrodynamic effects, through water entry. The expanded computer model generated by this analysis would allow prediction of water entry dynamics for launching advanced torpedo configurations from high speed surface platforms and would be capable of generating data suitable for expanded hydroballistic studies of water entry phenomena particular to the velocities, angles of attack and initial trajectory instabilities representative of a typical surface launched torpedo delivery.

71. TITLE: Composite Material Design for ASROC Launcher MK 112

CATEGORY: Engineering Development

DESCRIPTION: The MK 112 ASROC Launcher Mods 1 - 8 as well as the EX114 new guide has experienced and will experience corrosion and weight problems. Many of these problems can be rectified by fabricating many of the launcher components from high strength, light weight, corrosion resistant composite materials. Research is required into the various composite materials and their properties, and a design study must be performed to determine what components can be manufactured from what materials.

72. TITLE: Diver Hand Held Underwater Positioning System

CATEGORY: Advanced Development

DESCRIPTION: Concepts and ideas are solicited for a system that will enable divers to swim programmed paths or require specific positions in water depths to 200 feet. The system must be small enough to be deployed from small inflatable rubber boats by a three man team and operated by a single diver. It must also provide a capability for a diver to designate specific points along the programmed tracks to which he may wish to return.

All units must be self-contained and require a minimum of training and maintenance.

73. TITLE: Low Magnetic Signature, Low Power Consumption Sensor for Detecting Deeply Buried Ferrous Ordnance

CATEGORY: Exploratory Development

DESCRIPTION: Concepts and ideas are solicited for a sensor system capable of detecting deeply buried ordnance. The system must have a very low power consumption so that it can be configured for man portable use on the surface or underwater to depths of 300 feet. It must also present a very low magnetic signature so that it can be used in multiple sensor towed configuration without presenting a target to adjacent sensors.

If possible, the sensor should be capable of providing information about the ordnance item including size and burial depth.

74. Automatic Data Processing System for Side Scan Sonar and Magnetometer Data

CATEGORY: Advanced Development

DESCRIPTION: Concept and ideas are solicited for an automatic data processing system for analyzing side scan sonar and magnetometer data. The data is generated during underwater or surface applications and stored on magnetic tape or other applicable storage medium.

The system must be capable of programming to identify specific items of varying size, shape, or signature from the storage data. It must also be capable of interfacing with other data such as positioning or navigation data and producing output plots of specific item location in a searched area. Output in printed form listing item description (signature) and position.

75. TITLE: Nuclear Attack Submarine Integrated Communications Systems (ICS)

CATEGORY: Engineering Development

DESCRIPTION: A Data Link Communications System (DLCS) is being developed to provide over-the-horizon target detection, classification and targeting data for submarines equipped with the TOMAHAWK cruise missile. The DLCS effort will require development of R&D hardware to support technical and operational evaluation plus modifications to meet anticipated changes in communications networks. Additionally, ICS work will entail development of specifications for a high data rate bus architecture.

Technical Disciplines Required: DLCS is in the production phase. Minor system components such as switches SB-3916, SB-3918, and SB-3959 and a frequency stan-

dard transfer switch could be produced by small business. Small business could support operational testing and training (curriculm preparation and development). ICS (bus architecture phase) is in the concept exploration phase. Potential for work exists in specification preparation, technology assessment, modeling, simulation, human factors engineering and preparation of technical/cost benefit analyses.

76. TITLE: Submarine Integrated Antenna System

CATEGORY: Engineering Development

DESCRIPTION: This project consists of improving the design and frequency response of vertical submarine communications mast antenna systems, development of improved bouyant cable antenna handling mechanisms and development of both a new expendable and new towed buoy communications antenna.

Technical Disciplines Required: ELF, VLF, HF, and UHF spectrum antenna concepts, design and application in underwater environment; hydrodynamics; electro-hydraulic winch drive systems and fiber optic transmission lines.

77. TITLE: Applications for "Personal Computers" within NAVELEX

CATEGORY: Advanced Development

DESCRIPTION: Characterization of engineering, clerical and recordkeeping functions within NAVELEX. Estimation of efficiency increases in "throughput", decreases in cost or time and space savings, if any, resulting from the introduction of "Personal Computers" to the Command. Document thresholds and assumptions which if changed would influence the conclusion (i.e., cost of individual terminals, cost of memory, etc.).

78. TITLE: Basic Research in Electronics

CATEGORY: Research

DESCRIPTION: Focused basic research studies in electronics are of interest to NAVELEX in the areas of electronic materials development and fundamental device studies with emphasis on novel approaches to achieve goals of Navy interest - e.g., improved radiation hardness.

79. TITLE: Basic Research in Mathematics

CATEGORY: Research

DESCRIPTION: Focused basic research studies in mathematics are of interest to NAVELEX in the areas of command and control theory, communications theory, electronic component and system reliability analysis techniques, and mathematics theory that relates to undersea acoustics and surveillance.

80. TITLE: Basic Research in NAVELEX Applications

CATEGORY: Research

DESCRIPTION: Basic research studies that are focused on a single aspect of a

complex NAVELEX system are of interest. Areas of interest could include Electronic Warfare (EW) technology, communication systems, and satellite devices. Example type projects are, for instance, ones addressing new materials that have an EW benefit, a new antenna concept or a paper concept analysis of a new satellite.

81. TITLE: Innovative Architectural Approaches to C^3 Data Processing

CATEGORY: Exploratory Development

DESCRIPTION: Innovative architectural approach to C^3 data processing. Techniques should be robust enough to deal with impercise information and rapid interactions.

82. TITLE: Innovative Architectural Approaches to C^3 Networking

CATEGORY: Exploratory Development

DESCRIPTION: Innovative approaches to C^3. Techniques should adequately address technical problems associated with internetworking of heterogenous networks and measurements of performance.

83. TITLE: Synthetic Aperture Radar Detection High Speed Targets

CATEGORY: Research

DESCRIPTION: Synthetic aperture radar detection of high speed targets. Techniques should adequately address technical problems associated with signal processing and target classification.

84. TITLE: Acoustic Communications

CATEGORY: Exploratory Development

DESCRIPTION: Acoustic communications techniques will provide communications to submerged submarines. New acoustic communications concepts will be pursued commencing in FY 84.

The effort will address operational concepts and technologies, including propagation characterization, acoustic relay tactics and technology and varying depth sonobuoy transmitter concepts.

85. TITLE: Low Power HF Surface Wave Communications

CATEGORY: Exploratory Development

DESCRIPTION: Low power (less than 1W) HF communications is required with a minimum data rate of 1,000 bits per second over ranges of 300 to 500 nautical miles. The transmitting antenna must be suitable for relatively small oceanographic buoys not exceeding 6' in height and 18" in diameter. The receiving antenna and radio must be portable and suitable for operation on a ship or vehicle hoisted on the beach. The data rate and ranges indicated must be achievable year round over open ocean conditions through a diurnal cycle. Hardware demonstration is desired to show performance at some site to be

selected along the east coast. Support studies will project performance for different reasons and locations.

86. TITLE: Millimeter Wave Technology

CATEGORY: Exploratory Development

DESCRIPTION: Conduct a millimeter wave systems survey to identify R&D needs, critical problems and potential Navy systems applications for active millimeter wave devices such as field effect transistors, IMPATT devices, transferred electron devices, monolithic circuits, mixer diodes, and receiver protection devices. Survey results will be used to define a millimeter wave solid state service development program.

87. TITLE: Ocean Surveillance Research

CATEGORY: Exploratory Development

DESCRIPTION: A continuing technology program to improve the Navy's production and use of information from all surveillance sources. Research requires advances in mathematics and computer science for multiple source correlation, resource allocation and analysis techniques.

88. TITLE: Optical/UV/IR Communications

CATEGORY: Exploratory Development

DESCRIPTION: This project addresses Navy-unique system engineering and technology issues in the development of communication systems for submerged submarines using blue-green lasers in conjunction with advanced narrowband optical filters. Task areas include the design of affordable receivers and lasers, aircraft laser configurability assessments and communications system engineering. Aerospace laser transmitter technology will be investigated in FY 84.

89. TITLE: Power Supply Design Techniques for VHSIC 1.25 um and 0.5 um Technologies

CATEGORY: Exploratory Development

DESCRIPTION: The new semiconductor technologies being developed under the VHSIC program are driving the power supply voltage requirement down to the 1.5 to 3.0 voltage range from 5.0 volts. This will require the development of new power supply designs which have high efficiencies in the order of 80 to 90%. This high efficiency will be required to scale down the size and weight of the power supplies to a point where they would be compatible with the size and weight reduction gains of VHSIC. A reduction in power supply size and weight of a factor of ½ to ¼ will be required.

90. TITLE: RF Communications

CATEGORY: Exploratory Development

DESCRIPTION: The objective of this project is to increase the speed, versatility, and survivability of voice and data transmission systems to meet the needs

of real-time command and control of Naval Forces. This effort will investigate promising technologies and system concepts that have the potential to provide cost-effective enhancements to existing and planned communications systems. The comprehensive technical thrusts include:

- o Networking
- o ECCM Techniques
- o Submarine Communications
- o EHF SATCOM

91. TITLE: Satellite Countermeasures and Defense Program

CATEGORY: Exploratory Development

DESCRIPTION: An exploratory development program emphasizing techniques for hardening U.S. satellites against Soviet physical and electronic countermeasures while at the same time exploring vulnerabilities of hostile satellite systems in the same areas.

92. TITLE: Ships Electronic Warfare

CATEGORY: Exploratory Development

DESCRIPTION: Develop a broad technology base for missile and command/control/communications countermeasures. Areas of development include:

(1) Countermeasure techniques
(2) RF/IR/WO/TV single and multi-mode sensors guidance simulators and digital models
(3) IR/RF/EO absorbant and emissive materials
(4) Decoys and other offboard EW devices

93. TITLE: Telecommunications Exploratory Development

CATEGORY: Exploratory Development

DESCRIPTION: The Communications Exploratory Development Program includes the investigation of critical technologies and system concepts which offer potential for significant, timely, and cost-effective contribution to Navy operational effectiveness. These efforts address Navy-unique requirements for secure, reliable and survivable communications on a variety of operational platforms (i.e., airborne, surface, and subsurface).

94. TITLE: Increase the Bandwidth of the Band 9ALQ-99 TWT

CATEGORY: Advanced Development

DESCRIPTION: Develop a Helix band 9 Traveling Wave Tube (TWT) to replace 1/3 octave high cost coupled cavity TWT.

95. TITLE: Digital Safe and Arm Device for Guided Missile

CATEGORY: Advanced Development

DESCRIPTION: The current horological safe and arm devices reflect the need for a craft that is a dying art and has been one source of many production problems. The required innovation is a digital electronic device to time the launch and arm sequence of guided missiles and perform the safe and arm functions electrically as opposed to mechanically. The concept is that a good electronic design is more forgiving of low manufacturing skills than are watchwork components.

96. TITLE: Conventional Munition Guidance Stable Element

CATEGORY: Advanced Development

DESCRIPTION: The most cost and technology intensive device which militates against low cost guidance for conventional weapons/bombs is the stable element. The desired innovation is a frame of reference device which provides a stored memory in the guidance unit and emits initial commands to include up, down and port and starboard directions without restricting manuevers of the delivery aircraft.

97. TITLE: Technology Assessment/Evaluation Methodology

CATEGORY: Advanced Development

DESCRIPTION: The utilizaton of the most appropriate technology is the best means of keeping Naval Aviation ahead of all potential adversaries. The desired methodology would provide a means of assessing and evaluating those technologies which best meet NAVAIR needs. The methodology should allow identification of the best methods of categorizing, prioritizing and allocation of the best methods of categorizing, prioritizing and allocating of resources to the most promising technologies. Also included should be: the development of a means of recognizing viable and mature technologies and ways to recognize the technologies which need resource allocations to develop into mature and useful technologies.

98. TITLE: Biologically Produced Macro-molecules for Aviation Materials

CATEGORY: Exploratory Development

DESCRIPTION: Recent advances in genetic engineering promise an almost unlimited library of macro-molecules. It is expected that lubricants, adhesives, plastics, emulsifiers, cleaners, corrosion control chemicals and the like are potential end products of the science of genetics.

The purpose of this program is to obtain relevant research and development on predicting the properties of a wide range of macro-molecules and on actually creating, developing and demonstrating macro-molecules having potentially useful material enhancement properties. The R&D is expected to create an understanding of the opportunities and limitations in the building of macro-molecules using biological processes.

99. TITLE: Non-Destructive Testing and Inspection Techniques

CATEGORY: Advanced Development

DESCRIPTION: Recent scientific development in the area of ultrasonics internal friction damping, eddy current changes, X-ray line broadening are very useful. It is desired to develop innovative non-destructive testing to determine fatigue damage prior to cracking and/or residual stresses in critical aircraft parts. Another area of interest is the application of innovative ultrasonic measuring techniques to determine the location and size of defects in advanced composites.

100. TITLE: Innovative Coatings Research

CATEGORY: Exploratory Development

DESCRIPTION: New methods to incorporate novel coating to investigate:

(1) corrosion inhibitors to enable enhances corrosion resistance including arrestment of stress and fatigue corrosion.

(2) the chemical composition, microstructure and electrochemical properties to determine the important characteristics of a coating such as adhesion and corrosion protection.

(3) the incorporation of certain pigments into coating systems to reduce Radar cross section and/or reflectance in the infrared & laser spectrum.

101. TITLE: Biochemical and/or Molecular Engineering

CATEGORY: Exploratory Development

DESCRIPTION: Perform innovative research using new techniques involving biochemical and/or molecular engineering to produce unique materials for naval air applications i.e. new adhesives, coatings, ploymeric materials.

102. TITLE: Landing Gear Load Monitoring System

CATEGORY: Engineering Development

DESCRIPTION: Develop a simple, inexpensive system for measuring and recording loads introduced through Landing Gear on Navy aircraft. System should be capable of measuring bending, tension and axial forces on aircraft nose and main gear structural components.

103. TITLE: Repair of Laminated Composites Using Ultrasonic Method

CATEGORY: Advanced Development

DESCRIPTION: Classical approaches of repairing laminated composites by resin injection have not been consistently successful because the resin cannot flow into the narrow separation between plies. Innovation is desired in the application of ultrasonics to reduce the surface tension of resins and thereby enhance the flow. A study should be conducted to determine the parameters needed to enhance resin flow into delaminated composites. The method will be validated by repairing Navy supplied panels which will be inspected and tested statically and in fatigue.

104. TITLE: Synthesis of High Density Adamantane Monomers

CATEGORY: Exploratory Development

DESCRIPTION: The incorporation of adamantane structures into polymers is reported to increase stability and radiation resistance. New low cost methods of preparation would provide for application in volume limited missile systems as fuels, explosives or propellants.

105. TITLE: Aerosol Measurements Using Instrumented Aircraft

CATEGORY: Exploratory Development

DESCRIPTION: Extinction of laser radiation is of interest in optical countermeasures against laser-guided systems. The particle size of the aerosols enters into the extinction effect. The determination of the size distribution under various atmospheric conditions can be determined with instrumented aircraft designed for the purpose. It is desired to develop innovative instrumentation to determine the size distribution of aerosol particles.

106. TITLE: Environmental Satellite Development

CATEGORY: Exploratory Development

DESCRIPTION: Investigate innovative and inexpensive concepts for supplementary Major Satellite Systems with a support system. Design sensor, satellite and data processing equipment to generate environmental data in support of Numerical Models.

107. TITLE: Shipboard Relative Humidity & Slant Range Visibility Sensor Concepts

CATEGORY: Exploratory Development

DESCRIPTION: This task calls for a conceptual design of a relative humidity sensor and a slant range visibility sensor. Since the sensor are intended for shipboard operational use by Navy enlisted personnel, careful consideration shall be given to cost, reliability, maintainability, built-in-test (BIT) and ruggedness.

108. TITLE: Theory Applicable for Antennas Buried in Sea Water

CATEGORY: Exploratory Development

DESCRIPTION: Current theories are inadequate to predict radiation efficiency of such antennas for low frequency transmission from buoys or submarines. The research significance of this effort is that the use of an antenna imbedded in sea water vastly reduces the length requirement.

109. TITLE: Air Vehicle Warning Using Bistatic Radar Sonobuoys

CATEGORY: Advanced Development

DESCRIPTION: There is a need for new methods of low altitude attack warning

when aircraft radars are not available or are not effective. Innovative development to use sonobuoys which are configured as a bistatic radar fence are needed. The development must address the following issues:

- o Optimum deployment configurations and performance estimates
- o Sonobuoy transmitter spectral purity measurements
- o Bistatic processor configuration, with direct path excision
- o Wave masking effects from transmitter-to-target
- o Multipath effects
- o ECM response threat evaluation

110. TITLE: SIGINT Sensor For Shiplaunched RPV's

CATEGORY: Exploratory Development

DESCRIPTION: This low cost communications signal intercept, jamming, and decoy package would be deployed in shiplaunched remotely piloted vehicles (RPV's) to extend the communications ESM/ECM and ASW capabilities of the ship past the normal line of sight horizon. The remotely programmable intercept receiver, signal analyzer and transmitter electronics would exhibit sufficient sophistication to intercept unfriendly communications, identify them, and generate interfering emissions before vital reconnaissance and targeting information could be communicated to other attack forces. The occurrence of these events would simultaneously be transmitted back to the ship by the RPV communications link providing early warning and approximate direction of an approaching attack force. The electronics would also contain the ability to emulate and transmit friendly communications signals sequenced according to typical operational scenarios. This feature would provide the capability to use the RPV in a decoy/deception mode of operation with location and timing control unavailable with other resources such as buoys. The electronics package would be less than 550 cubic inches in volume, less than 8 lb. in weight, and consume less than 25 watts average power when operated in the jamming and deception modes.

The work would consist of making a preliminary concept design of the SIGINT SENSOR/jam/decoy package.

111. TITLE: Long Haul HF Command/Data Link for Buoys

CATEGORY: Exploratory Development

DESCRIPTION: This low cost HF link for remote buoys would provide a command/data link between a central control station and multiple sensors comprising a field over an area of radius up to 1500 nautical miles. It would provide an attractive alternative to satellite links used for this purpose with the advantage that the survivability would be much higher than satellites during time of war. Also, the combined use of narrowband signalling, low transmit duty cycle, time diversity and low data rates would enable the data to be communicated with less peak power than normally required for satellite links. The links would also provide near real time data reporting to the central control station which is often not possible with satellite links. The HF buoy link equipment would be less than 400 cubic inches in volume, less than 5 pounds in weight, and consume less than .2 watts average power.

During the first year work would be undertaken to make preliminary conceptual

design of a HF system. Subsequent efforts would be: (1) to demonstrate over land a narrow band HF system using off-the shelf equipment and (2) at sea demonstration employing HF buoy link electronics.

112. TITLE: On-The-Bottom Surveillance Buoy

CATEGORY: Exploratory Development

DESCRIPTION: An Air ASW sensor contained in an "A" size sonobuoy package which sinks to the ocean floor can provide a long life Air ASW surveillance capability. This may be done by combining the long detection ranges achievable by on-the-bottom sensors employing the Reliable Acoustic Path (RAP) with sophisticated, programmable, low power-consumption and very small in-buoy acoustic processors that extract submarine acoustic radiations and provide contact reports. This compressed data could be transmitted to the surface by burst acoustic communications on a programmed schedule that meets patrol aircraft Readout Revisit Requirements. A standard passive sonobuoy, deployed by the readout aircraft may be used to relay the contact report(s) to the readout aircraft. Acoustic data transmission avoids the complexity and high cost of an electromechanical link to the surface. This concept has a large force multiplier effect because it permits coverage of much larger ocean area in a given amount of time.

The proposal effort would be to make a preliminary conceptual design of a compressed data burst acoustic communications link. Subsequent efforts would be:

(1) Conceptual design of bottom-positioned acoustic buoy with in-buoy acoustic processors undertaken in second year of program and (2) Fabrication of demo unit for lab test of processor/link undertaken in third year and (3) Fabrication of sea test unit(s) for test during fourth year of project.

113. TITLE: Multiple Dimensional Ship Imagery

CATEGORY: Research

DESCRIPTION: The use of imaging sensors from aircraft and weapons to classify ship targets requires the near real-time multiple dimensional correlation of sensor image features with physical features of ship targets. Real environments of multiple contacts and multiple sensors create an information management burden on operators to simultaneously direct sensors, sort images for quality, synthesize images from combinations of range only, 2-D and 3-D sensors. Research and technology development is required on algorithms for computer-aided (on aircraft) and fully automated (in weapons) processing of image data. Needed are: measures of image quality based on 3-D statistical correlations of features; techniques for curved object segmentation using local edge interpretations; inferential procedures for partially occluded features; image synthesis criteria and rules; and hierarchical structures for classification hypothesis that contain numeric and non-numeric information necessary to sort and track multiple contacts. The long-range targeting and terminal guidance phases of engagements present different problems.

Expert systems approaches for classification decisions and production rule methods for image sorting, synthesis and hypothesis pruning are research areas of artificial intelligence that are appropriate for investigation.

114. TITLE: Analytical Decision Making Software

CATEGORY: Engineering Development

DESCRIPTION: Develop software, useable on a minicomputer system in Basic, capable of analyzing general project cost, quantity and delivery schedules against selected criteria and normalized historical data base. Further, the software will be interactive to allow statistical manipulation of the data using call up programs.

115. TITLE: Ocean Instrumentation

CATEGORY: Research

DESCRIPTION: Proposals are being solicited in support of new development in ocean instrumentation. Emphasis will be on work relating to devices which measure physical quantities both in situ and remotely. Such quantities include, but are not limited to, ocean surface height, water temperature, salinity and current, pressure, color, optical transmissivity, air/sea fluxes of heat/water vapor momentum. In addition, new navigational techniques which enhance such measurements are also included.

Emphasis will be on device production where a complete system is proposed. Priority is given to techniques involving simple deployment and include aircraft/satellite, ship, free drifting, free fall, and moored configurations.

Proposals may involve the improvement of existing techniques as well as component improvement. Utility to the basic research community is given high priority.

116. TITLE: Development and Exploitation of New Acoustic Measurement Techniques

CATEGORY: Research

DESCRIPTION: The Navy needs sophisticated sensing techniques and materials with specific properties including reliability. More accurate, reliable, and versatile acoustic techniques for sensing and measuring parameters of interest to the Navy will provide options and improvements in instrumentation for sensing operational parameters and for characterization and reliability assurance of Naval materials. There has been in recent years a trend toward renewed interest in exploiting the power of acoustic measurement techniques, especially those that are only now possible with our rapid advances in other technologies and in computing power. There is a need for basic research that will develop innovations in acoustic methods for measurement of parameters of fluids and solids and advance the state-of-the-art in acoustic measurement instrumentation. Acoustic techniques, both new and old (especially when implemented with state-of-the-art instrumentation and computer support) are capable of achieving results previously not practically attainable. Acoustics often offers unique solutions to problems. The interests are to conceive and demonstrate proof-of-principle for innovations in acoustic measurement methods and to implement some of them in ways that will find applications. These range from the experimental validation of existing theoretical results to the putting together of several proven techniques heretofore not used in combination. The applications include nondestructive evaluation, transducer calibration and

characterization, materials research, measurement of radiated noise and other sound fields, and sensing of environmental parameters.

117. TITLE: Acoustic Detection of Remote, Low Altitude Nuclear Burst at Sea

CATEGORY: Advanced Development

DESCRIPTION: Over the past two years the theoretical base has been developed for using long path underwater acoustic signals to detect low altitude nuclear bursts at sea. This research has reached a state where it should enter the development cycle and be reduced to practice.

Initial effort would be the development of algorithms and software for determination of location, yield and height of burst. Once developed the accuracy can be verified using existing acoustic data from previous nuclear tests at sea.

Further development would be required to obtain and set up proper monitoring equipment at underwater listening stations and to establish a single center for analysis of data from all stations. A likely choice for the analysis center would be the Naval Ocean Research and Development Activity (NORDA).

118. TITLE: Remote Sensing of the Atmosphere Profiles for Variable Constituents and Properties

CATEGORY: Research

DESCRIPTION: Proposals are being invited in both observational and theoretical approaches to geophysical problems and phenomena. Techniques and ideas are sought for the sensing of variable constituents such as water vapor, ozone, nitrogen oxides, particulate matter (including number and size of hydrometeors) ion content and for physical properties such as temperature, refractive index, wind velocity and shear. Type of remote sensing interest includes radar (including millimeter) laser, infrared and acoustic. Passive techniques are of special interest. Proposals submitted should also give consideration to rapid processsing and readout and effective display of data.

119. TITLE: Automating the Processes of Developing and Maintaining Computer Software

CATEGORY: Research

DESCRIPTION: The process of developing and maintaining Computer Software is very costly, moreover it utilizes scarce manpower resources. The cost of software comes both before it is released to the fleet, due to design and testing, and for many years after release when it must be modified to meet changing requirements and conditions. Both activities are manpower intensive. The promise for alleviating this problem lies in automating as much of the software process as possible, particularly focusing on those areas which are labor intensive. There exist now an excellent opportunity to begin research on basic science that will cause a quantum jump in the automation of the software process. Specific research areas include:

- o Very high level languages and systems which can automatically translate specifications into tested, verified, efficient code;

- o Automating the routine, editorial tasks a programmer does and which detract from the important work of conceptualizing and designing;

- o Use of artificial intelligence techniques for automatic programming, debugging, documentation and maintenance; as aids in conceptualizing and designing software; and to aid in the management of software;

- o Technologies, such as program visualization, to aid the automation process, and to be utilized in all phases of software from requirements to maintenance.

- o Evolution of software over long periods of time, and utilizing this property to automatically create new versions from old.

120. TITLE: Classification/Document Control Procedures for Tactical Development/Evaluation Support Program

CATEGORY: Management and Support

DESCRIPTION: There is a need to design and evaluate alternative advanced MIS and Library functions that will provide up-to-date and continuous document control systems for TAC D&E Support Program. The design should include a classification system with several indenture levels and cross reference capabilities; a procedure that will maintain positive control over documents in the system, yet allow system user to retrieve documents quickly and accurately. In addition the system should be compatible with related agency internal MIS Systems for contract monitoring and budget contol as well as interface with the Naval Tactical Support activity's document system.

121. TITLE: Quantitative Non-Destructive Evaluation of Composite Materials

CATEGORY: Research

DESCRIPTION: Graphite-epoxy composite materials are increasingly being used in critical Naval structures and structural components in view of their high specific strength and high specific modulus. In order to ensure and assess the integrity of these graphite-epoxy structures, reliable methods for the detection and characterization of damage, together with methods for the assessment of criticality of such damage, need to be developed. These non-destructive evaluation methods, preferably noncontacting or non-invasive, should be suitable for field application and should yield reliable quantitative information regarding the size, orientation and location of flaws.

122. TITLE: Photoelectrochemistry

CATEGORY: Research

DESCRIPTION: The Navy's complex weapon, propulsion, communication and sensing systems require specialized electrochemical power sources and processes. Progress in the development of new electrochemical power sources and processes requires a better understanding of the chemical and physical structure of electrochemically reactive materials and of the rates and mechanisms of the electrode processes involved. One area of electrochemical research currently of interest is photoelectrochemisty. Information needed in this area includes:

the electrochemical behavior and stability of semiconductor materials in photoelectrochemical processes; techniques for preparing chemically-modified photoelectrodes; the photoelectrochemical properties of modified electrodes; photoelectrochemical processes occurring in nonaqueous-based electrolytes and the impact of such processes on the operation, efficiency and reliability of photoelectrochemical systems. Research should emphasize kinetic and mechanistic studies of well characterized photoelectrodes, the development of the theory of the process, the electrode-electrolyte interface and the adsorption of molecules at the electrode surface. Aspects of photoelectrochemistry related to the chemistry of etching, degradation and processing of electronic materials and the development of application concepts based on photoelectrochemical processes are of interest.

123. TITLE: Hydrodynamics

CATEGORY: Research

DESCRIPTION: Hydrodynamic research areas of interest include both the fundamental mechanics of fluids and ship hydrodynamics. Work in the fundamental mechanics of fluids should be generic in nature, serving to advance the knowledge of basic fluid physics and to provide the foundations for advanced ships, propeller and underwater weaponry designs. Specific areas of effort include theoretical and experimental research on such phenomena as turbulence, transition, boundary layers, cavitation, cavity flows, separation and wakes. Work in ship hydrodynamics should specifically address the basic issues unique to the hydrodynamic performance of Navy ships and submarines. Included here are wave resistance, drag reduction, hull/wake interactions, and hull/propeller interactions for prediction of ship resistance, ship motion and propeller performance.

124. TITLE: Techniques for Test-Scale Equating for Computerized-Adaptive Testing

CATEGORY: Research

DESCRIPTION: There is a strong possibility that the Defense Department will be using item-response theory to adaptively administer and score its entrance tests beginning sometime in 1985. If this happens, it is anticipated that the periodic development of new test forms will be obviated and that instead, new test questions will be added to the pool and old ones deleted from the pool continuously. This process of continuously changing the item pool, and therefore the test, raises a number of theoretical and practical questions for which we have no ready answers: Among the most important are questions concerning the stability of the subtest and composite equatings.

Test equating is the process through which scores on one psychological test are mapped onto scores on a second equivale est. Test equating is most often used when old test forms are to be replaced with new test forms or when a set of equivalent tests are to be used interchangeably. In these circumstances, test equating is often the primary means of establishing both the norms for, and the validity of, a new test. If, through a succession of equatings, the score scales drift, the validity of the norms and the relevance of the validity data must be questioned.

With a traditional approach to test development, score-scale drift is sometimes

reduced by equating successive new test forms back to the same anchor test. In the adaptive-testing environment described above, this process is impractical for it would require a new equating study each time a test question is added or deleted from the pool. A new test-equating technology is one possible solution, but not necessarily the only one, to the problems discussed above.

125. TITLE: Integrated Logistic Support Plan (ILSP) for a Combined MIFASS and TCO System

CATEGORY: Engineering Development

DESCRIPTION: The Tactical Combat Operations (TCO) System is expected to be significantly reduced in scope and combined with the Marine Integrated Fire and Air Support System (MIFASS). The combination of these two systems is possible due to extensive commonality of hardware and software. A decision to combine these two systems is expected soon. The ILSP for MIFASS has been completed but requires revision. A preliminary ILSP has been completed for the orginal TCO System which reflects the TCO requirements before the scope of the system was reduced. An ILSP will be needed which will combine the logistic support requirments of the current MIFASS System and the projected TCO System.

126. TITLE: Integrated Logistics Support Plan (ILSP) for Joint Tactical Information Distribution System (JTIDS)

CATEGORY: Engineering Development

DESCRIPTION: The Marine Corps will acquire JTIDS Distributed Time Division Multiple Access (DTDMA) terminals to support tactical communication. An ILSP needs to be developed to support acquisition.

The tactical Air Operations Central-85 and the Marine Corps Tactical Air Command and Control Center will be the initial host platforms scheduled for JTIDS integration.

127. TITLE: High Frequency (HF) Log Periodic Array

CATEGORY: Engineering Development

DESCRIPTION: As requested by the reference, the requirements exists to upgrade the quality and reliability of long distance (HF) transmission paths for MAB/DIV/MAW/FSSG units which is at present marginal to unsatisfactory. This requirement will be improved by the procurement of a highly directional, sky wave propagating, log periodic HF antenna system capable of high gain at low take off angles. Desired characteristics are as follows:

a. Trailer mounted base, transportable in a 5 ton vehicle (M-923).

b. Telescoping mast to a minimum height of 40 feet.

c. Mast head capable of being rotated from ground while antenna is erect.

d. Antenna must be compatible with current and projected HF radio equipments.

128. TITLE: Voiceware Development System

CATEGORY: Advanced Development

DESCRIPTION: The system will be utilized with the Simulated Tank Anti-Armor Gunnery System (STAGS). The system should allow tank/anti-tank gun crewmen the ability to give and receive verbal commands to a computer either individually or as a crew.

129. TITLE: Development of a Prototype Acoustic Detection System

CATEGORY: Advanced Development

DESCRIPTION: The Acoustic Detection System (ADS) is a small, lightweight, man-portable sound amplification system to extend hearing range by a factor of two. Hand-held or clipped to the rifle, it will amplify sound to the user via cables and headphones, and will be frequency capable in the 50Hz-15KHz and 15K-30KHz ranges stepped down via a frequency reduction circuit to the 15Hz to 15KHz region. A noise limiting circuit in the headphones will automatically switch-off if the amplified earphone noise level exceeds 85-90 db.

130. TITLE: Development of a Prototype Helicopter Landing Zone Lighting System

CATEGORY: Advanced Development

DESCRIPTION: The HLZ Lighting System is a small lightweight system for use on night helicopter assaults when pilots are wearing Night Vision Goggles (NVGs). Each light must be capable of directional illumination and remote activation by a coded radio beacon. The system must not "white out" the NVGs or impair normal night vision.

131. TITLE: Tactical Weapons Effectiveness Study of Anti-ship Missile Systems Using Automatic Target Recognition

CATEGORY: Exploratory Development

DESCRIPTION:

1. The Cruise Missile type weapons systems are pushing the target engagement range further and further out. The search area within the uncertainty ellipse gives a low probability of detecting the target ship from other ships in the background. The weapon effectiveness in terms of numbers of missiles to sink the right ship, i.e., surgically strike the threat ship, will be greatly improved in the missile can discriminate and recognize the target ship.

2. A weapons effectiveness analysis is required to show the relative benefits of missile system with and without (1) automatic ship recognition, (2) range data and assuming both Non-Cooperative Target Recognition (NCTR) and Cooperative Target Recognition (CTR). Analysis must include the effect of positive logic, i.e., recognize the right ship, and negative logic, i.e., don't know exactly which ship is to be hit but it's known which ships are not to be hit.

NOTE: This effort will require Secret clearance if real cruise missile or HARPOON parameters are used vice a generic missile.

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D.3 AIR FORCE SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

I. INTRODUCTION AND GENERAL INFORMATION

1. The purpose of the Air Force's portion of the Small Business Innovative Research Program is to stimulate technological innovation.

2. This portion of the brochure is organized to facilitate timely submission of proposals by small businesses directly to the laboratory or product division which will ultimately evaluate the proposal. Listed in the next section are the addresses to which proposals should be submitted. In section III are the topics that the Air Force is interested in investigating through the Small Business Innovative Research Program.

II. PROPOSAL SUBMISSION

Proposals for SBID Air Force topics should be addressed to:

Topic 1:

AFOSR/XOT
Bolling Air Force Base
Washington, DC 20332

Topic 2:

AFHRL/TSMM
Brooks Air Force Base
Texas 78235

Topic 3:

AFRPL/TSPR
Edwards Air Force Base
California 93523

Topics 4 and 5:

AMD/RDO
Brooks Air Force Base
Texas 78235

Topic 6:

AFGL/XOP
Hanscom Air Force Base
Massachusettes 01731

Topic 7:

AD/DLOU
Eglin Air Force Base
Florida 32542

Topic 8:

AFWL/PRP
Kirtland Air Force Base
New Mexico 87117

Topic 9:

RADC/DORP
Griffiss Air Force Base
New York 13441

Topic 10:

AFWAL/XRPF
Wright-Patterson Air Force Base
Ohio 45433

Topic 11:

AFWAL/XRPM
Wright-Patterson Air Force Base
Ohio 45433

Topic 12:

AFWAL/XRPA
Wright-Patterson Air Force Base
Ohio 45433

Topic 13:

AFWAL/XRP-PO
Wright-Patterson Air Force Base
Ohio 45433

Topic 14:

SD/YLXT
PO Box 92960
Worldway Postal Center
Los Angeles, CA 90009

Topic 15:

ESD/TOE
Hanscom Air Force Base
Massachusetts 01731

Topic 16:

AEDC/DOT
Arnold Air Force Station
Tennessee 37389

Topic 17:

AD/CZO
Eglin Air Force Base
Florida 32542

Topic 18:

BMO/PMX
Norton Air Force Base
California 92409

Topic 19:

ASD/XRU
Wright Patterson Air Force Base
Ohio 45433

AD-A165 942 DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR) FY 1983(U) DEPARTMENT OF DEFENSE WASHINGTON DC 31 MAY 83 2/2

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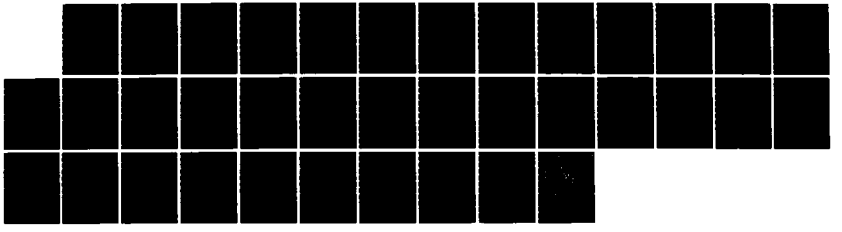

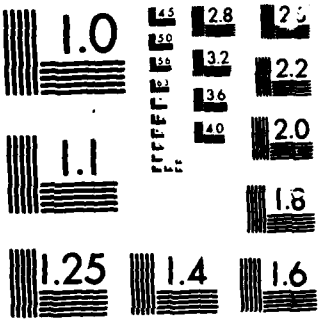

III. TOPICS

1. General Science and Engineering. The Air Force Office of Scientific Research (AFOSR) exercises Air Force executive management responsibility for Air Force basic research. It awards grants and contracts for research in the basic sciences directly related to Air Force needs. AFOSR has interest in any new and innovative ideas which are involved in the search for new knowledge and ideas which are involved in the search for new knowledge and expansion of scientific principles. For FY83, AFOSR has special interest in multi-disciplinary initiatives in the following areas related to space.

a. This initiative will include programs for research to provide fundamental information on new materials, structures, and structural dynamics leading to improved stable spacecraft with extended life. Chemistry and materials research will focus on new ceramic, polymeric, and carbon-carbon concepts for dimensionally stable, environmentally resistant space composites; vibration damping materials; and non-welded, in-place joining and space processing of multiple composite units. Structural dynamics research will address active distributed control concepts and modeling for shape control, orbital transfer dynamics, and damping enhancement, and nonlinear large motion dynamic modeling for slewing and attitude control. AFOSR/NC

b. The objective of this program is to advance fundamental techniques for automatic analysis of images collected from space based sensors. The desired techniques should be able to provide timely, intelligent, semantic descriptions of the content of the image. The scope of this program is intended to address many topics and involve several disciplines. Valid topics for investigation include image processing algorithms (such as image encoding, image models and representation, 3-dimensional analysis, neurophysical fundamentals, image registration, analysis of time-varying images, multispectral analysis of images and novel architectures (digital, optical, or hybrid). Efforts based on neurosciences, mathematics, computer science, artificial intelligence, or electronics approaches are sought. Integrated efforts addressing several topics and involving multiple investigators and disciplines are encouraged. AFOSR/NM

c. This initiative will provide fundamental information on new materials for performing key roles in preventing enemy engagement of and reducing damage to next generation spacecraft. Research will focus on absorbing and obscuring materials including smokes, laser resistant materials, processes of evaporation/condensation and dissipation in space, radiation damage, and storage properties of potential materials systems. AFOSR/NM

2. Human Engineering and Training. The Air Force Human Resources Laboratory (AFHRL) manages and conducts research and development programs in simulation, education, training, and personnel use technology. AFHRL has interest in any new and innovative ideas which include these areas. For FY83, AFHRL is interested in furthering research and development of teaching and training techniques.

a. An effective method is needed for identifying and applying relevant aspects of newly emerging microelectronics technologies to initial phases of aircrew training. A procedure is needed to determine least-cost electronics media options for training many academic and early phase aircrew procedural cognitive tasks. At least three major variables interact in such determina-

tions: (1) task variables, the parameters which define human behaviors associated with procedural/cognitive task accomplishment; (2) electronic media capabilities, the hardware/software system characteristics applicable to training requirements; and (3) instructional variables, the pedaogogical specifications required for optimal training interaction between learner, media, and task. A system should be developed by which the elements within each of the three categories can be related and matched in order to determine the essential characteristics of least-cost training systems required for given tasks. The outcome of the concept development would be a demonstration in which the derived classification/analysis system was applied to a major training problem in order to produce the specifications for a least-cost, optimal capability training system to teach specified tasks. AFHRL/XR

b. The operational readiness of tactical C^2 elements is attenuated by the difficulty of teaching complex skills and the lack of opportunity to practice them. The problem requires a two-part solution: (1) the educational technology to teach complex situation assessment and decision making skills, and (2) the application of low-cost micro-computer technology appropriate to impart, measure, and maintain these skills. The feasibility assessment phase of this effort requires that the successful offeror identify and evaluate critical situation assessment and decision making requirements within selected elements of tactical Air Force command and control systems. Once critical training requirements are identified, they shall be matched and evaluated against both current educational and existing micro-computer based technologies to determine whether the development of complex skills trainers are with the current state-of-the-art. If determined feasible, the documentation shall include a functional description of the configuration and cost requirements for developing such a trainer. These specifications shall include provisions for automated skill assessment and for the maintenance of skills once critical behaviors have been acquired. The successful completion of this study shall require that the winning offeror work closely with the potential user (to be selected jointly by the contractor and the AFOM) to: (1) identify critical behaviors, (2) determine user requirements, (3) facilitate the eventual implementation process, (4) insure that the product is responsive to dynamic user needs, and (5) insure the acceptance and usability of the assessment measures for improving training and performance. The recommendations and documentation that result from this feasibility study shall fully consider the requirements and constraints of a subsequent goal of combining individual trainers into a multi-station team training configuration that addresses critical team training issues.

3. Rocket Propulsion Technology. The Air Force Rocket Propulsion Laboratory (AFRPL) plans and conducts research and development to provide timely rocket propulsion technology options for Air Force systems. The AFRPL program comprises over half of the national investment in rocket propulsion technology. AFRPL has interest in any new and innovative ideas in rocket propulsion technology. ARPL has interest in any new and innovative ideas in rocket propulsion technology. For FY 83, AFRPL is interested in techniques for fabricating large inflatable reflectors.

This acquisition is for an applied research program to demonstrate that inflatable reflectors can be made with surface accuracy to within 0.1 mm rms for diameters of 10-30 meters. A three task effort is anticipated as follows: Task 1: Determine from film manufacturers the current methods of manufacturing thin films in widths as large as 30 meters. Determine the cost and schedules

associated with these materials. Investigate methods for forming films in special or controlled configurations. Determine minimum thicknesses that have been used. (NOTE: The goal here is not to develop a new technology but to determine the cost of applying current techniques to the large reflector.) Task 2: Investigate alternate seam configurations, including the use of different materials for the seam and the gore. Experiment with additional bonding agents (heat activated, glue, tape). Determine the effect of various seam widths on structural integrity and ease of assembly. Seaming configurations to be studied shall include: (1) An all seam layup (fully overlapped gores), (2) tapered wedge-shaped butt joints and (3) material removal at seams which are then joined with thin tape. Task 3: Construct two 3-meter paraboloids using the best of the above techniques. Measure actual surface contours under pressure and the rms deviation from the desired shape. AFRPL/DYA

4. Biotechnology. The Air Force Aeromedical Research Laboratory (AFAMRL) specializes in theoretical and experimental biotechnology research and development in biodynamics, human engineering, combined aerospace stress effects, and toxic hazards. It is a center of excellence for noise research. AFAMRL has interest in any new and innovative ideas which are involved in these areas. For FY83, AFAMRL is interested in techniques to develop injection molded visors.

The purpose of the effort will be to assess the feasibility of developing new injection molding techniques for producing optical quality parabolic and toroidally-shaped visors for use in helmet-mounted sights and displays. The technique must allow the mass production of these visors at a low cost using acrylic and polycarbonate materials. Suitable techniques for assessing the quality of the visors are also needed. Specific contours for the visors will be provided by the Air Force. AFAMRL/TSQ

5. Aerospace Medicine. The United States Air Force School of Aerospace Medicine (USAFSAM) conducts biotechnology research and development, medical evaluation and education, consultation, and aeromedical support for the USAF. Investigations encompass laboratory and clinical studies in all areas of physiological, environmental, and dynamic conditions which may affect the health and performance of Air Force personnel under a variety of operational circumstances. USAFSAM has interest in any new and innovative ideas within these areas. For FY83, USAFSAM is interested in prosthesis technology.

Technology in prosthesis engineering has advanced remarkably in the past decade and offers a foundation for closer coupling of man and machine (pilot and aircraft). This contractor will prepare a state-or-the-art assessment of this technology, perform a critical analysis of potential USAF applications, and conduct preliminary design studies for systems to couple pilot and aircraft. USAFSAM/TSQ

6. Geophysics. The Air Force Geophysics Laboratory (AFGL) is the center for research and development in geophysics and conducts research in missile geophysics, upper atmospheric and stratospheric operations, ionospheric effects, the optical/infrared environment, meteorology and the space environment. AFGL has interest in any new and innovative ideas involving these areas. For FY83, AFGL is interested in technology for measurement of water vapor.

The initial effort will consist of developing models simulating water vapor

profiles to determine the response of a multi-frequency microwave radiometer to a realistic range of variables encountered in the atmosphere. The results of this effort will be used to design and prepare the specifications for a satellite borne multi-frequency microwave radiometer capable of obtaining water vapor profiles in clear and cloudy atmospheres. AFGL/XOP

7. Munition Technology. The Air force Armament Laboratory (AFATL) is the principal Air Force laboratory performing research and development of free fall and guided non-nuclear munitions and airborne targets and scorers. These include chemical and fuel-air explosives, energy sources and conversions, electronic and mechanical devices, bombs, dispensers, fuzes, flares, guns, and ammunition. AFATL has interest in any new and innovative ideas in munition technology. For FY83, AFATL is interested in shaped charge, self forging fragment, and solid state slapper detonator development.

a. The objective of this program is to evaluate the importance of liner microstructure to warhead design by comparing the performance of a material with a nominally superplastic microstructure and identical alloy, but which has microstructural characteristics more in line with current volume production methods. AFATL/DIJW

b. The objective of this program is to determine the feasibility and applicability of batch produced slapper detonators and hi-voltage switches utilizing micro-electronics and micro-machining technology. Feasibility is defined as actual construction and firing of a sample detonator and switch. AFATL/DLJF

8. High Power Technology. The Air Force Weapons Laboratory (AFWL) conducts research and development programs in laser and particle beam technology, nuclear weapons effects and safety, and nuclear survivability and vulnerability. AFWL has interest in any new and innovative ideas in directed energy and nuclear technology. For FY83, AFWL is interested in high power technology.

a. A microwave device is needed which would have applications in high power, high resolution radar, plasma heating, linear accelerator drivers, ground to space power transmission, military electronic countermeasures, etc. Such a device must be compact (Smaller than 30 cubic meters, excluding prime power source), tuneable over a factor of 10 in the GHZ portion of the spectrum, capable of narrow and broadband emission, and having a power output in the tens of GW, single pulse, one microsecond per pulse. AFWL/NTYP

b. A high current, high voltage opening switch is needed for a variety of pulse power applications, including flash x-ray generation, charged particle acceleration, mass drivers, etc. The need is for single shot as well as repetitive switches. For single shot devices, an opening switch capable of handling 50 megamps for five microseconds, opening in times less than 200 nanoseconds is desired. For reprating, a switch is needed to direct one megamp, opening time 20 nsec, reprate 1-10 kilohertz. AFWL/NTYP

c. There is an Air Force requirement for a repeated explosively or magnetohydrodynamic (MHD) driven power source. Current research in magnetoflux compression generator (MCG) technology aims at designing efficient single shot devices. Present MHD devices can operate CW at modest levels. A need exists for a transportable power source having an electrical output of 0.5 megajoule

per pulse, 10 pulses/sec, pulsewidth of 10 microseconds, 100 pulses run time. AFWL/NTYP

9. Electronic Component Reliability. Rome Air Development Center (RADC) is the principal organization charged with Air Force research and development programs related to command, control, communications, and intelligence. RADC is responsible for advancing this technology and also demonstrating selected systems subsystems in the areas of intelligence, reconnaissance, mapping and charting, and command, control and communication. RADC has interest in any new and innovative ideas in the above areas. For FY83, RADC is interested in the following areas:

a. The technology for Monolithic Microwave Integrated Circuits (MMIC) has advanced to the point that they are being considered for system applications that may require as many as 1,000,000 MMICs. The MMIC approach has the potential for low cost in production. Projections to date show that the testing of MMICs will be a substantial portion ($\geq$25%) of the total circuit cost. New innovative solutions to the testing of MMICs will be required if their full cost benefit is to be realized. MMIC transmit/receive modules for phased arrarys are recommended as a vehicle for this study. RADC/OCTP

b. Sources are sought to develop a software cost estimation model capable of accurately predicting costs in the conceptualization/formulation stages of embedded systems acquisition. The model must be vendor independent, since it is DoD's policy to make competitive awards whereever possible. RADC/COE

c. There is a pressing need for vitreous optical materials which are continuously transparent from the ultraviolet to the mid infrared region of the spectrum. Applications for such glassy materials include, but are not limited to, multispectral optical components such as lenses, windows, solid state lasers, and Faraday rotators for optical switching and IR domes as well as low radiation-hard optical waveguides operating in the 2-8 micron regime. The recent discovery (1977) of new families of non-oxide halide glasses based, for example, on the fluorides of various heavy metals, offers a glassy material transparent in the 0.1-10 micron region. R&D sources are sought for an interactive research program on the preparation of heavy metal fluoride glass samples of large sizes (10 cm dia x 1-1/2 cm thick). The contractor should be capable of preparing fluoride glasses of various compositions. The work will include development of techniques to yield reproducible glasses with low water and impurity content. Also the contractor should be able to prepare heavy metal fluoride glass in different shapes. The contractor shall characterize glasses developed in the course of this program in terms of their optical, thermal, and mechanical properties. RADC/ES

d. The Air Force has a requirement to identify/characterize ground and airborne tactical targets at remote distances. Preliminary research has indicated that it may be feasible to derive signatures of transmitting targets by analysis of the transmitted signal and its perturbations caused by reflections from obstructions on the target. A signal processing technique (Cepstrum Analysis) which enables separation of a signal and its echoes has been considered for this application. The application of Cepstrum Analysis and/or other processing techniques to the identification/characterization problem requires further investigation. Areas which must be addressed include determination of appropriate processing technology and its application to the

development of unique signatures for various classes of targets. RADC/IRAE

e. The development of the read/write optical disk for mass storage systems logically leads toward the need to update and upgrade stored information. The ability to selectively erase and rewrite information would greatly reduce the cost of the optical disk. Future proliferation of the optical disk in mass storage systems coupled with increasing data rates and storage requirements will necessitate using a reuseable optical disk instead of a non-eraseable optical disk in reat-time mass storage systems. RADC/IRAP

f. The pattern recognition efforts in automatic feature extraction of digital imagery, multi-dimensional image processing and multi-imagery exploitaton system (MIES) are addressing image processing and artificial intelligence applications within existing processing system and are not adaptable in AI problem situations more complicated than a simple neighborhood situation. The objective of this effort is to define the target detection and pattern recognition problem in terms of artificial intelligence rules and develop a plan for application to the imagery hierarchy and develop a knowledge base for the most difficult of image pattern recognition problems. Define the process of pattern recognition (target detection and identification) such that a computer can rapidly go from the image problem situation to the particular AI rules that it suggests. Develop a plan that will determine how the AI techniques should be best applied to the imagery hierarchy. Based on the plan and processes defined, develop a knowledge base that represents the image patterns to be recognized including the most difficult of image pattern recognition problems including CC&D targets, seasonal changes and ambiguities representative of all imagery types. This program will provide a pattern recognition and target detection knowledge base and rules for global pattern recognition in a digital image. RADC/IRRE

g. As a result of exploratory development effort during FY82 and FY 83, the technical feasibility of applying decision analytic (DA) artificial intelligence (AI) and operations research (OR) techniques to the planning of discrete portions of the Offensive Counter Air Mission planning process has been demonstrated. The discrete decision aids currently address the problems of target prioritization/selection, mission planning (nomination of aircraft from known assets) and route planning. The decisions were developed independently using a variety of hardware and software tools. In order to demonstrate and exploit the full potential of the DA, AI, and OR based decision aids for Tactical Air Force (TAF) application, the feasibility of integrating these aids into an advanced development model is required. The vertically integrated decision aid suite will be developed within a scenario of TAF operations beginning with the Commander's apportionment decision and carrying through to individual pilots selecting ingress and egress routes from targets. The first phase will address the feasibility of integrating this technically adverse set of aids into a vertically integrated set to address the functional requirements of Offensive Counter Air Mission planning from target nomination to pilot route planning. Contingent upon successful feasibility study results a second phase will be undertaken to integrate the decision aids into an advanced development model for demonstration and evaluation. The aids will be made as uniform as possible with respect to man-machine interactions and will operate on a common data set in a single thread scenario. Evaluations are to be performed from technical and operational Tactical Air Force perspectives. RADC/COAD

h. The technology for Monolithic Microwave Integrated Circuits (MMIC) has

advanced to the point that they are being considered for system applications that may require as many as 1,000,000 MMICs. The MMIC approach has the potential for low cost in production. Projections to date show that the testing of MMICs will be a substantial portion (≥25%) of the total circuit cost. New innovative solutions to the testing of MMICs will be required if their full cost benefit is to be realized. MMIC transmit/receive modules for phased arrays are recommended as a vehicle for this study. RADC/OCTP

i. There is a pressing need in DoD for highly durable optical fibers both for high strength applications such as towed missiles, rapid pay-out cable and undersea cable, as well as high reliability application of a strategic or tactical nature. Moreover, increased durability of optical fibers date no single method has a proven capability for long lifetime without a decrease in dynamic fiber strength and/or fiber transmission characteristics. An interactive research program on the preparation of optical fibers hermetically coated to be used in long-line communication systems under severe environmental conditions is contemplated. The contractor should be capable of depositing under vacuum, metal and diamond-like carbon coatings on long length, low loss, high bandwidth, state-of-the-art graded index optical fiber drawn from CVN preforms producted by the contractor. The coating applied by plasma ion deposition techniques, should be in-line and non-conducting. Also the contractor should be able to conduct strain-rate analysis and detailed fatigue testing on the coated fibers.

10. Flight Vehicle Technology. The Flight Dynamics Laboratory (AFWAL/FI) develops technology for design and fabrication of future aerospace weapons systems. The laboratory also conducts configuration research of advanced vehicles, performs engineering simulation, and develops experimental flight vehicles to demonstrate new technologies. The laboratory is the Air Force focal point for non-nuclear survivability and vulnerability and atmospheric electrical hazards study. The laboratory has interest in any new and innovative ideas which include these areas. For FY83, the laboratory is interested in the following areas.

a. Reductions in aircraft life cycle costs can be achieved by reducing maintenance costs and extending structural life. This is accomplished through development of design and repair methods to improve structural element durability and damage tolerance. Research efforts are needed to provide improved understanding of and predictive methods for the failure process in structures and engineering materials, including the indentification, characterization and analytical modeling of critical parameters. The failure processes include property degradation (residual strength), fatigue damage accumulation, crack iniation and propagation, and fracture. Critical parameters include loading and environmental factors such as temperature, moisture, vacuum and electromagnetic radiation. Specific research in durability should focus on metallic alloys and super-alloys for high temperature applications and advanced composite materials using polymeric resins or metallic matrices. AFWAL/FIBE

b. Spacecraft systems developments in the Air Force are moving in the direction of large spacecraft structures with distributed electronics and sensors. Integrated with these systems are concepts including power systems and cryogenic refrigeration subsystems which must perform reliably and demonstrate efficient energy management techniques. Fundamental technical challenges will arise from implementing advanced spacecraft analysis and design efforts which include processing megawatts of energy and waste heat. Therefore, tech-

nological advancements are required for the development of spacecraft thermal management techniques in which waste energy from power sources, cryogenic refrigeration devices, and electronics is effectively managed and utilized for power generation and environmental control of heat transfer by radiation. Approaches currently being considered include analysis of heat powered refrigeration cycles for spacecraft thermal control and the establishment of spacecraft heat transport technology to effectively manage the enormous amounts of energy and waste heat generated in future spacecraft systems. AFWAL/FIEE

c. The effective and efficient interface between human (Pilot) and machine (Aeronautical/Aerospace Vehicle) is critical to mission success. Research and development efforts are required to develop and effectively integrate new technologies directed at minimizing crew workload. One specific area is the development of mathematical models of the dynamic interaction between the human pilot and the flight control system which involves internal processing and decision making as well as discrete and continuous control inputs. Adequate mathematical models of these dynamic interactions are needed in all piloted system design studies and developments to insure flight safety and promote aircraft reliability, as well as to optimize the flying qualities and response characteristics of the piloted system. Current mathematical models require extensions to permit analytical consideration of realistic flying tasks characterized by large amplitude motions with time-varying or non-linear dynamic behavior. AFWAL/FIGC

11. Materials Technology. The Materials Laboratory (AFWAL/ML) manages Air Force research and development in matreials and manufacturing technology programs. Is also plans and conducts specific programs in materials research designed to reduce cost, improve reliability and performance of aircraft, missiles, spacecraft, and support equipment. The requirements of advanced generations of weapons system will not be met without significant advances in materials technology and the kind of farsighted materials research programs which will make advances possible. AFWAL/ML has interest in any new and innovative idesa in materials technology. For FY 83, the laboratory is interested in the following materials technology research areas.

a. In Air Force systems today, materials are operating at or near their capacity with regard to stress, temperature and environment. Yet, it is necessary to prolong use of current systems, and to envision new ones which will demand lighterweight structures of extreme reliability and with resistance to corrosive attack or sudden failures. A rational basis for creating or improving material systems (such as alloys, polymers, glasses, ceramics, and composites) is required and should be obtainable through understanding of the principles that govern proprerties and behavior as a function of microstructural features composition, and processing parameters. This should lead to a methodology to obtain families of new or improved materials without the expensive and time-consuming trial-and-error approach which characterizes current state-of-the-art. In order to reach beyond the present limitation, understanding of the factors that control material properties and behavior is required. Specific needs encompass concepts for reliable high strength iron base alloys (240-260 ksi), aluminum and titanium alloys with high modulus/density ratios, weldable high strength aluminum alloys for aircraft structures applications, metal matrix composites with high strength and high modulus to density ratios, and alloys specifically formulated for powder metallurigal fabrication of high structural efficiency and high temperature components. The need for analytical

modeling is particularly acute in the field of thermally-protective materials. Such materials are typically composites in which the fibers and matrix are both carbonaceous substances and fibers are oriented in two or more directions. AFWAL/MLLS

b. Fundamental knowledge is needed for polymer characterization to confirm molecular structure and determine physical and chemical property correlations. These are needed as guidance to the synthesis of monomers, oligomers, prepolymers, polmers, and resin systems which offer desirable balances in properties, namely with respect to environmental stability, processability, mechanical behavior and costs to fulfill current and future requirements. Fundamental structure-property correlations are needed to interrelate physical and mechanical properties with engineering properties, and ultimately the correlation of these with modecular and super-molecular structures. This elucidation and application of fundamental polymer structure-property correlations is essential for the development of synthesis and processing chemistry needed to generate new resin systems. Further, a technical basis must be provided for the reliable prediction of the use properties from the polymer structure and properties of candidate materials for advanced matrix resins, adhesives and molecular composites. AFWAL/MLBP

c. Approaches are needed to the synthesis and characterization of polymeric materials specifically tailored in molecular structure for new, improved matrix resins and adhesives. Included are (a) high molecular weight processable polymers exhibiting high thermal stability which by virtue of chemical additions, cycloadditions or rearrangements can be cured to high strength materials, (b) polymers containing a high degree of chain rigidity which can be ordered (and/or oriented) and processed to high strength materials, (c) reactive oligomers capable of being converted to environmentally resistant, high molecular weight, high glass transition temperature materials by controlled chemical addition reactions and/or molecular rearrangemnets, and (d) low polymers or prepolmers which can, without the production of by-products, be chemically cross-linked to high polymer networks with excellent resistance to thermochemical and mechanical environments and stresses. This also includes research to provide improved new polymer forming reactions and approaches to the synthesis of specifically structured chemical intermediated, multifunctional monomers and cross-linking agents required to product the above polymeric materials.

d. New approaches leading to higher temperature performance of nickel, aluminum, and titanium alloys and ceramics are required.

- Nickel Alloys. Research is required to identify thermodynamically stable oxidation-resistant turbine engine blade and vane materials possessing high melting points and significantly improved stress rupture and fatigue properties. An improved basic understanding of rapidly solidified power metallurgy is especially important in view of its potential for producing alloys with superior properties.

- Titanium Alloys. Research to identify approaches leading to the formation of new titanium alloy systems capable of sustained operation at temperature up to 1600°F are needed for advanced propulsion system critical components such as blades and disks.

- Aluminum Alloys. Research to identify approaches leading to

aluminum alloy systems capable of sustaining repeated high stresses in the 450° to 650° temperature range are required for advanced aircraft critical components.

- Ceramics. Research to identify new families of ceramic materials capable of economical consolidation and possessing improved creep, thermal stress, and static fatigue resistance is needed to extend the limits of future generation high temperature turbine engine components. An improved understanding of the design, fabrication, and properties of ceramic matrix composites is especially important.

- Metal Matrix Composites. Reseach to identify approaches leading to the development of metal matrix composites with high impact resistance for use in turbine engine blades and vanes. AFWAL/MLLM

e. Predictability of the effects of corrosion on the loadbearing capability of structure requires fundamental knowledge of chemical, electrochemical, mechanical and metallurigal influences, and their interaction. Durability, which has direct impact and life-cycle cost of Air Force systems, is severely limited by hostile environments. Because the degradation of structural integrity by corrosion is a highly coupled phenomenon, sophisticated analytic and experimental skills from diversified fields will be needed to address the problem. AFWAL/MLSA

f. Cumulative damage models for metals and composites due to timevarying loading and environments are required as a basic building block for life predictions. This model should be derived for laboratory-size specimens with and without stress concentrations. Effects of mean stress, positive and negative stress ratios, combined stresses, overloads, rate and frequency of loading, hold time, load sequencing and damping need to be investigated. Materials can then be designed to a required relaibility. AFWAL/MLLN

g. The performance, reliability, and durability of many aerospace systems depend directly on the availability of improved functional fluids and lubricants. Currently used functional fluids are highly flammable and lack intrinsic oxidative and thermal stability at high temperatures. There are also significant needs of wider termperature range lubricants and higher temperature greases. Synthesis approaches to new high molecular weight, low vapor pressure chemical systems molecular weight, low vapor pressure chemical systems molecularly tailored to lower flammabilities, increased stabilities and broadened fluid ranges are needed. The synthesis and characterization of new synthetic fluids, for example alfa olefins, silahydrocarbons, and polyalkybenzenes, and associated additives to improve their chemical and physical properties are required to replace petroleum-based fluids which may be increasingly more limited in availability in the future. Fundamental studies aimed at improved understanding of the molecular structure-property relationships of these fluids and lubricants and improved understanding of the mechanisms of their thermal and chemical degradation under use environments, for example in the presence of metallic species, oxidizing agents or other substances capable of enhancing degradation, are required to guide future synthesis efforts and to permit prediction of the behavior of these materials in service. AFWAL/MLBP

h. Nondestructive evaluation plays a major role in the production, operational safety, and maintenance of Air Force systems. Current emphasis has largely been on the inspection of components, subassemblies, and entire

systems during or following manufacture, throughout their service lives, and as part of any maintenance and repair procedures. The items to be inspected, their service conditions, and their requirements or definitions of acceptability are thus tremendously varied. Research in this area includes the study of physical, chemical and mechanical phenomena which can be used as techniques for the detection of any feature in a material or component which could, under some service conditions, be considered a deflect or flaw; the study of mechanisms underlying these phenomena to permit the extration of quantitative information about the nature of any defects or flaws that are detected; and studies of the methodology underlying the structuring of improved accept-reject strategies. Research is needed to improve the theoretical and experimental understanding of existing and new NDE techniques to accurately and reliably detect the existence, formation or growth of flaws in materials and coatings of interest, including metals, ceramics, organics, composites and various electromagnetic devices and systems. For example, research is needed on electromagnetic, ultrasonic, and new or improved methods of detecting both bulk and surface cracks or other defects arising from manufacturing operations, fatigue, corrosion, impact, or radiation damage. Also, the interrelationships between defects on both microscopic and macroscopic levels and the behavior and the quality of materials or components must be determined. This information will guide the development of NDE techniques by defining the nature, size and distribution of the defects or flaws that must be detected and characterized, and will thus contribute to an improved basis for the development of rational accept/reject criteria. Research on the factors which influence the reliability and accuracy of NDE measurements is needed to maximize the probability of detecting defective materials or parts while at the same time minimizing the liklihood of costly rejections of satisfactory ones. AFWAL/MLLP

i. The design and management of manufacturing functions and methods have in the past been largely ignored by the scientific and technical communities. As a result, the processes and practices currently in use have largely evolved through trial and error and the timely solution on a case-by-case basis of specific manufacturing problems. The current emphasis on productivity enhancement, resource conservation and quality improvement, coupled with the technological opportunities that are now emerging, particularly as a result of the tremendous reduction in cost and increase in computational speed and capacity of computers, both suggest an increasing need for interdisciplinary manufacturing science research efforts.

In the area of intelligent manufacturing task automation, research is needed on improved models to describe the tasks to be performed, the economic and other productivity implications of the processes to be used, and the means of acquiring, storing and accessing the data to be used in process planning and control; sensors for visual or other means of part recognition and spatial location, for force, torque or tactile information acquisition, and for the determination of geometric and internal material characteristics are needed to provide information for in-process quality assurance and process control; simulation equipment for modeling manufacturing processes and material behavior under conditions of processing; and control theory, adaptive learning, artificial intelligence and other branches of computer science related to the problem of acquiring and rapidly processing the huge volumes of manufacturing process information that would be available are required for intelligent, self-optimizing, closed-loop adaptive control of flexible, automated manufacturing processes, of advanced robots, and of complex manufacturing tasks such as aero-

space system assembly. AFWAL/MLBE

12. Electronic Technology. The Avionics Laboratory (AFWAL/AA) develops electronic technologies for airborne systems. Research is centered around reconnaissance, weapon delivery, navigation, electronic components, communications, electronic warfare, and software. This technology is used to develop radar and electro-optic sensors, fire control computers, precision inertial reference systems, miniaturized digital memories, signal processing warning receivers, adaptive jammers, and information processing systems. AFWAL/AA has interest in any new and innovative ideas which include advances in electronic technologies. For FY 83, the laboratory is interested in the following avionics technologies.

a. Gallium Arsenide memories may well have access times of less than a nanosecond. There are two aspects that require study. First, what does this increased access speed mean to the throughout of signal processors and how is the memory architecture affected. Second, what are the advantages of having both logic and memory on the same integrated circuit chip. Perhaps, this integrated logic-memory approach is mandatory if the access speed of the memory is to be preserved and not lost in driving on and off memory and logic chips. Simulation to verify the analysis is preferred. AFWAL/AADE

b. The metal ceramic helix is a promising canidate for RF circuit applications in traveling wave tubes. It consists of a helically wound metal ribbon with an outside cladding of a congruent thick ceramic layer. The complete RF circuit is composed of a tublar outer barrel into which the composite helix is tightly fitted. Until now, the lack of quantitative knowledge on the RF properties of this circuit has prohibited applications of this RF circuit impractical traveling wave tube designs. Rational design engineering approaches require information on the frequency dependence for (a) the phase velocity, (b) the characteristic impendance, and (c) the longtidinal coupling impedance (on axis). These quantities are needed as a function of the essential parameters such as relative ceramic shape and thickness and helix pitch as depending on the frequency. It is the objective of this study to develop these data through a theoretical study. AFWAL/AADM

c. Several attempts have been made to vapor deposit aluminum nitride on copper substrates. Thicknesses of up to eight mils have been obtained before erratic growth. Anisotropic pyrolytic boron nitride (APBM) is thought to have a higher figure of merit (ratio of thermal conductivity to dielectric constant) than aluminum nitride. It is proposed that an effort be initiated to deposit samples of boron nitride on to copper substrates at thickness up to 0.68 meters. AFWAL/AADM

d. The use of composite materials in the fabrication of waveguides for airborne applications is a promising area for investigation. Materials such as graphite and/or Kevlar can be used to fabricate lighweight, high strength, dimensionally stable structures with mechanical and electrical properties nearly equivalent to standard aluminum waveguides. It is desired that several sections of X-band waveguide be fabricated such as straight sections, bends, and a directional coupler. These sections must exhibit the insertion loss, conductivity, VSWR, power handling capability, temperature response, and coupling of standard aluminum waveguides. The most critical area of composite waveguide is the inner conductive wall of silver or aluminum which must be approximatley three to six miles thick with less than one ohm per cm^2 resistivity across the

surface. The conductive lining must adhere to the composite while being uniform, parallel, and perfectly smooth with no bare spots, surface pits, scratches, or nicks. The finished lining imperfections must not constitute more than one percent of the total coated surface and not be concentrated in one local area. Flanges made of composite material must also be attached to the waveguide to provide coupling to other sections without sacrificing electrical performance. In general, it is desired to fabricate lightweight composite waveguides with the characteristics of standard aluminum waveguides. AFWAL/AADM

e. Research in the electromagnetic theory and information processing area is required to develop methods of extracting target information from its far field pattern directly. This information could then be utilized for target identification and also for providing phase information relating to motion characteristics of either the target itself of the illuminating platform. This research would consist of two primary sequential components: (1) Electromagnetics (E-M) theory research concerning far field representation of target phenomena, and (2) Artificial intelligence implementation which would develop the E-M theory "expert" with associated adaptive processing. The first application of this technology is seen to be in the synthetic aperture radar (SAR) area since SAR in essence reconstructs, through elaborate phase compensation, the far-field pattern over a limited aperature and frequency regime of the target during the imaging process. AFWAL/AARM

13. Aero-Propulsion Technology. The Aero-Propulsion Laboratory (AFWAL/PO) plans and conducts research and development in air-breathing propulsion, flight vehicle power, fuel, lubricants, and fire protection. AFWAL/PO has interest in any new and innovative ideas which include the above areas. For FY 83, the laboratory is interested in advances in the following areas.

a. Air Force requirements in energy storage and power generation devices cover a wide range of research areas including electrochemistry, superconductivity, plasma physics, advanced optical measurement techniques and thermal energy conversion, control, storage, and heat transfer. Specific research will be conducted in non-aqueous electrolyte batteries and new electrode/electrolyte combinations which could provide vast improvements in energy density, low temperature operation, power density and cycle/storage life. Research in superconductors will aim at approaches toward understanding and reducing losses in Type II superconductors due to time-dependent fields. Optical techniques such as Laser Induced Fluorescence, Coherent Anti-Stokes Raman Spectroscopy and Photo-Acoustic Spectroscopy will be studied along with fast optical detectors and absorption spectroscopy using pulsed tunable diode and dye lasers. Plasma studies will include nonequilibrium plasmas, electron collision cross sections, plasma chemistry and lifetime improvements for closed cycle lasers, power conditioning and high voltage switching, advanced diagnostics for temporally and spatially resolved phenomena and plasma chemistry studies in rf discharges. Thermal studies will be conducted to investigate phase change materials, liquid metal heat pipes and the transient behavior of integral heat pipes. The distributed evaporator, liquid pump enhanced heat pipe concept, and thermal energy concepts for pulse power loads will also be investigated. AFWAL/POO

b. Turbomachinery of low aspect ratio and high stage loading will be investigated with the goal of reducing the manufacturing and maintenance costs and improving the mechanical integrity of aircraft turbine engines. Analytical

methods will be upgraded to include three-dimensional the time-unsteady effects. Controlled experiments and advanced instrumentation will be used to obtain a better definition of three-dimensional and time-unsteady features of the turbomachinery gas path. Design innovations such as leading-edge sweep, variable fillet geometry and unconventional airfoil optimization techniques will be evaluated experimentally. AFWAL/POTX

c. The objective of this research task is to increase understanding and utilization of the technical disciplines encompassed by solid mechanics of structureal systems as they relate to the optimum design and performance of airbreathing propulsion systems. Advanced theoretical and experimental methods will be developed for the analysis and evaluation of the structural behavior of turbine engine components and systems. Static and dynamic response of turbine engine components will be investigated using state-of-the-art structural analysis techniques. Problems of current Air Force importance in this area include transient and steady-state structural mechanical response of turbine engine blading and discs. Efforts will investigate bladed-disk structural response using image-derived holographic interferometry. Research will be carried out to study the phenomena of damping and blade mistuning with regard to their effect on modal response of the bladed-disk system. Dynamic structural behavior disc systems will be studied under stimulated and actual turbine engine operating environments. AFWAL/POTC

d. The objective of this program is to conduct analytical and experimental studies of the fluid dynamics, chemical knetics and combustion dynamics relevant to the development of advanced supersonic and hypersonic ramjet propulsion systems for strategic and tactical missiles. Representative test configurations, involving the turbulent mixing and combustion of high-speed heterogeneous fuel-air streams, will be investigated under conditions representative of those encountered in integral rocket-ramjet propulsion systems. Extensive experimental effort will be undertaken to develop a broad base of parametric combustor performance and instability data as well as detailed flow field measurements using gas sampling, laser velocimetry, and flow field visualization techniques. AFWAL/PORT

e. The objective of this reseach is to expand the technology base in the areas of combustion dynamics, fuels combustion, as well as fire and explosion protection for Air Force weapon systems. The emphasis of the work in combustion dynamics is experimental investigation of combustors of varying complexity. Measurements obtained from laboratory experiments will be used to validate and improve mathematical models of combustion under fluid flow conditions encountered in aviation gas turbine combustors and afterburners. In the area of fuels combustion, effort will concentrate on the formulation of a mathematical fuel combustion model that includes the effects of the chemical and physical properties of hydrocarbon fuels. In fire and explosion protection, effort will focus on formulating a mathematical model for the hot surface ignition of fuels, lubrications and hydraulic fluids. Experimental effort will be performed to provide data needed to formulate and validate the mode. AFWAL/POSF

14. Space Systems Technology. Space Division (SD) manages all system programs to acquire space systems/subsystems, support equipment, and related hardware and software. SD also performs advanced development technology on programs which support future space mission needs. In this latter capacity, SD is interested for FY 83 in any new and innovative ideas in the following areas:

a. COSMIC Ray Interference. The objectives are: (1) Investigate material to shield digital/space equipment to protect against cosmic rays interference to accurate equipment operation. (2) Establish LSI process/ design constraints to minimize hazard.

System Program Offices (SPO) have reported loss of information in their digital computer(s). This loss has, so far, been detected and corrected through programming techniques. There may be other problems which have not been detected and may be more serious in long term effects.

Guidelines for mateial or equipment configuration to protect against cosmic ray interference, are the technology product desired. SD/ALT

b. Gallium Aresenide (GaAs) Processer Technology. The objective is to study and develop GaAs technology to support the future design and development of full baseband signal processing. GaAs offers high speed, low power consumption, and radiation hardness. By extending the current MSI/LSI GaAs integrated circuit complexity into the VLSI and eventually VHSIC regions, a number of signal processing functions can be combined into, and performed by, a single chip. This extension of GaAs IC technology could lead to substantial increases in processing capability and greatly enhance autonomy and survivability of future MILSATCOM systems.

Present MILSATCOM systems suffer from insufficient processing capability due to the large weight and power associated with todays processing technology. Additional problems include limitations on speed and radiation hardness. GaAs technology has the potential to solve all of these problems. Before the advantages of GaAs can be exploited, however, we must develop IC's of greater complexity. Once VLSI and VHSIC GaAs IC's evolve, full baseband processors operating at very high speeds and requiring very little power will be possible.

To extend the development of GaAs technology into useful VLSI and VHSIC, the government should take several steps. First, we should track and study current GaAs development efforts. From this ongoing study, we should form a development schedule which drives the development and use of GaAs VLSI and VHSIC chips in full baseband signal processors. The government labs should take the lead in pushing the technology to meet the development schedule. They can accomplish this through device design and modeling, development of practical multichip circuits, applications tests in subsystem breadboards, and reliability life testing. By tracking industry, and coordinating government efforts, we can expediantly and efficiently drive the current MSI/LSI level GaAs IC's into the realms of VSLI and VHSIC, and begin development of a VHSIC GaAs full baseband processor.

Technology product desired is the development of GaAs IC's to support a future baseband signal processor program. SD/YKX

c. V-Band Crosslink Amplifier (60 GHz). The objective of this effort is to develop and demonstrate a space-qualified, millimeter-wave (60-63 GHz), solid-state power amplifier for crosslink (satellite-to-satellite) communications application. Performance goals include a power level of 5-10 watts, 10% efficiency and a 10 year operational life.

Crosslink communication requirements impose high reliability and long life

constraints on the amplifier. The communications capacity requirements make a 5-10 watt amplifier a desirable size. At 60 GHz, present devices cannot provide this power level. In addition, the reliability of the most promising technology, IMPATT diodes, is not established. An adequate, well characterized circuit design is also necessary before this technology can be considered sufficiently low risk for a space-borne application.

That a prototype amplifier be developed for anticipated space use is a suggested approach. Design and initial testing should anticipate the requirements of the space environment and specifications and standards tailored accordingly. Emphasis should be placed on IMPATT diode optimization and development of a broadband combiner/amplifier configuration.

Technology product desired is space qualifiable 60-63 GHz Solid State 5-10 W Amplifier. SD/YKX

d. 60 GHz Crosslink Antenna Subsystem. The objective is to develop a transmit/receive steerable-beam antenna subsystem with acquisition and tracking capability. This subsystems design must be compatible with the requirements of a cross-link (satellite-to-satellite) communications system. We project the following design goals:

EIRP	60 dBw
G/T	25 dB/°K
Bandwidth	1 GHz
HPBW	0.35 degrees
Acquisition Angle	Hemispheric Coverage
Pointing Error	+ 0.02 degrees
Beam Pointing	150°/second
Acquisition Time	6 second
Acquisition and Tracking	±0.8 degrees/within 6 seconds
DC Power	Minimum

Satellite-to-satellite data links will be an essential part of future C^3 systems. To be successful, cross-links must have very high EIRP and very narrow half power beamwidths (HPBW). These requirements demand that acquisition and tracking modes be extremely precise. To achieve the high EIRP, narrow HPBW, and extreme accuracy required of future cross-link antenna systems, development is needed in several technologies.

Suggested approach is to develop cross-link antenna technology, develop, study and tradeoff several acquisition and tracking techniques including monopulse and conical lobe methods. Also, study several types of reflector configurations which present alternate antenna designs. Identify any high risk technology and components necessary for a 60 GHz cross-link subsystem, and begin appropriate hardware development.

Technology product desired is a 60 GHz crosslink antenna subsystem study which makes tradeoffs, recommends a design, and identifies high risk areas. Hardware development of critical high risk technology and components. SD/YKX

e. 44 GHz Low Noise Receiver Front End. The objective of this task is to study the development of a highly reliable, space qualifiable, 44 GHz low noise front end receiver for space-borne applications.

Currently, the three possible candidates for use in a 44 GHz low noise front end are cooled and uncooled peramps, use of image rejection mixer diodes for down conversion followed by an intermediate frequency (IF) high gain receive amplifier, and low noise FETs followed by amplification used directly at 44 GHz. Preamps, especially cooled systems, add unnecessary size, weight, power drain, and overall assembly complexity and are unacceptable for space-borne applications. Image rejection mixer technology is preferred over the use of low noise FETs above 30 GHz. This is because the noise figure associated with low noise FETs increases proportionately to the square of the frequency. At 44 GHz, the noise figure associated with low noise FETs is currently unacceptable. Novel new design approaches and greater control of manufacturing processes are needed to reduce the noise figure and increase the gain of low noise FETs at 44 GHz. The advantage of using low noise FETS, if the noise figure can be reduced, is that they provide initial amplification which reduces amplication noise in the high section that follows. Image rejection mixer diodes, while providing virtuallly no amplification, have very low noise figures and allow down conversion to frequencies where amplification can occur with less noise. Both low noise FET and mixer diode approaches should be studied for new ways to reduce noise with increased amplification.

Initially, a study should be implemented to compare the 44 GHz low noise FET approach to the image rejection mixer diode approach. Emphasis should be placed on making novel improvements to these approaches such as the use of III-V heterojunction materials for the low noise FET's, or use of different IF frequencies and high gain amplifier configurations after the mixer diodes. Some development work may be required as part of this study. Consideration should be given to following this with an advanced development hardware effort using a preferred approach from the study.

Technology products desired are 44 GHz Low Noise Front End receiver study with recommendation of a preferred technology approach and hardware development of preferred approach. SD/YKX

f. FHF Downlink Solid State Amplifier (20 GHz)

The objective is to develop a space-qualified EHF solid state amplifier for on-board space system implementation. Solid state offers the potential for a considerable increase in reliability and operational life, as well as lower weight than TWT's for similar applications. The following characteristics are design goals:

1. 20 watt RF output.

2. 20.5 - 21.5 GHz.

3. 15% DC to RF conversion efficiency.

4. 30 db gain.

5. 10 years useful life.

Space-borne applications for EHF amplifiers require efficient, reliable designs. The communications requirements result in a minimum practical output power of about 20 watts. Traveling wave tubes offer one solution to

meet these requirements but have reliability shortcomings which are being addressed elsewhere. Several approaches exist for the use of solid state technology in transmit amplifiers. Gallium aresenide (GaAs) IMPATT (Impact Avalanche Transit Time) diodes or GaAs FET's (Field Effect Transistors) can be used in a circuit combined approach with small size and weight, but with relatively large combining losses and low power. Alternatively, GaAs FET's can be used in a far field combining approach (i.e., active apperture antenna) which minimizes circuit losses, allows multiple steered beams, and provides reasonable power, but which places severe size and weight constraints on the spacecraft. There are significant problems remaining to be solved in the areas of device doping profiles, packing resonances and thermal resistance, device efficiency, and circuit frequency optimization, reliability and space-qualification.

Gallium aresenide IMPATT's and FETs should be investigated. The effort should result in the analysis, test and space-qualification of amplifiers using each type of device.

Technology product desired is space-qualifiable 20 GHz Solid State Amplifier. SD/YKX

g. Spaceborne Mass Storage Devices.

The objective is to develop a replacement for tape recorders to store large amounts of data in a binary format in a spaceborne environment. Storage capabilites in the order of 10^9 bits and continuous operation of seven years with high reliability without external maintenance is required. The memory readout should be non-destructive with positive controls to prevent unauthorized alteration of memory content during all phases of operation. The technology used should be hardened to $5X10^6$ rads (Si) total does as a minimum.

Past orbital failures have demonstrated the need to replace the currently used mechanical-magnetic tape recorders with higher reliability devices.

New memory device technologies, such as magnetic domain tip motion devices (e.g., the magnetic "bubble" devices) and charge-coupled devices are canidate units for replacing magnetic tape recorders. Monolithic, solid state units construed in the form of a large number of circulating memory loops could significantly improve the access time and reliabilites of current mass-memories. Also promising are electro-optical, laser operated systems that in the 1980s may provide high bit storage capacity with significantly reduced access time. Testing and evaluation of candidate replacement units should be conducted under environmental extremes that will be encountered on-orbit.

Technology product desired is space-qualified mass storage devices with a capacity on the order of 10^9 bits. Ideally these devices should be interchangeable with magnetic rape recorders on existing space systems. SD/YDMS

h. Remote Sensing of Meteorological Parameters.

Objective is to develop spaceborne sensors capable of providing data on the meteroroligical parameters necessary to accomplish the mission of the Defense Meteorological Satellite Prograsm (DMSP). Listed below are meterological parameters for which an improvement over the present capability

of the DMSP sensors is desired. The present DMSP capability and the eventual goals are both listed on the attachment. An improvemnt of 30-40% or more over present capability in any of the areas listed would be of interest.

PARAMETER	Present/Goal		Present/Goal		Present/Goal		Present/Goal	
Vertical Mositure Profile	None	5nm	None	100-1000 Ft	None	1nm	None	± 1%
Vertical Temperature Profile	125nm	5nm	5K-15K Ft	100-2000 Ft	50nm	1nm	± 5°k	± 1°k
Visibility (wave length 0.4-0.7nm)	None	5nm	None	500-1000 Ft	None	1nm	None	± .5nm
Winds	None	5nm	None	100-2000 Ft	None	1nm	None	± 5% nte 2m/s
Surface Temp	None	5nm	N/A	N/A	None	1nm	None	0.5°C
Soil Moisture	12nm	1nm	N/A	N/A	6nm	1nm	None	± 10%
Sea State	None	1nm	N/A	N/A	None	1nm	None	±3nm amplitude ± 5% wavelength + 10° direction

While sensors currently in use by DMSP provide much useful data, improvement in the capability of these sensors is desired. The accuracy of data provided by DMSP is a limiting factor in the making of accurate and timely weather forecasts and any improvement in DMSP sensors would permit an improvement of weather forecasts.

Technology products desired are new management techniques or approaches, improvements in critical sensor components and subsystems, and proof of concept sensors for use on future DMSP satellites. SD/YDMS

i. Composite Materials. The objective is to develop lighweight, structurally stiff, and thermally, insensitive materials for use on the Defense Meterological Satellite Program. These materials would find useful application for the satellite precision mounting platform and are potential canidates for other satellite aplications, e.g., adaptors, trusses, etc. These materials must be sufficiently strong to survive launch loads and exhibit suitable properties for long term operations in 450nm polar orbits.

The problem is sensitive sensor systems require a highly stable mounting platform to retain stringent pointing requirements. Coefficients of expansion and stability properties of typical spacecraft materials makes sensor alignment difficult. Some composites, especially graphite-epoxy have a virtu-

ally zero coefficient of thermal expansion and a high strength to weight ratio. Use of these composites could result in a significant weight savings, simplified thermal control and greater versatility in instrument mounting requirements.

The technology product desired is flight qualified composite materials for use on new generation DMSP satellites. SD/YDMS

15. Electronic Systems Technology. Electronic Systems Division (ESD) conducts all technology development applied research through acquisition for command, control, communications, and intelligence (C^3I) systems and ground electronic systems. For FY 83, ESD is interested in any new and innovative ideas in the following areas:

a. The objective of this project is to conduct a study to identify hardware features, capabilities and engineering requirements needed to implement a secure computer system in which the security attributes of the system are resident in the hardware and not the software.

While current and near-term proposed secure systems have emphasized implementing secure operating systems on standard hardware architectures, this study seeks to define an architecture which will satisfy all computer security requirements and greatly reduce the need for independent verification and validation of systems and applictions software to obtain security certification.

This is a new task proposed to provide computer security standards needed to satisfy Air Force requirements for secure computers. ESD/TOEE

b. The objective of this project is to conduct a study of computer network security and define hardware and systems software requirements for making the computer components of networks secure. The computers at the nodes of communications links have not been evaluated and the hardware security features and requirements defined well enough to establish standards or develop prototypes. This project will develop requirements and specifications and then acquire, integrate and test a network.

This is a new task proposed to satisfy urgent requirements identified by the major air commands to provide definitive guidance for development of secure computer networks. The motivating force behind this project is the great proliferation of computer systems serving major air commands/separate operating agencies management, command and control, and logistical support requirements via dedicated local area and commercial communications networks.

These requirements dealing with digital communications security are well enough defined, through numerous studies conducted by the Services and NSA, that definition of the computer requirements (hardware features, operating and communications software, applications software) must now be addressed. Essentially, the technology for secure communications between computers is relatively well defined, and in some instances the systems are being developed. However, the computers at the nodes of communications links have not been evaluated and the hardware security features and requirements defined well enough to establish standards and develop prototypes. ESD/TOEE

c. The objective of this task is to develop a system for computer security threat data collection, analysis, and modeling in support of the Air

Force Computer Security Program.

The Air Force Computer Secutiry Program Office has been directed to:

Distribute historical hazard/threat information, analyses, and predictive data. Consolidate threat information to formulate an overall computer security threat model.

Provide ADP threat analysis information to MAJCOM/SOA ADP Program Single Managers, Designated Approving Authorities (DAAs), and/or Program Management Offices (PMOs). Further, provide a data base of ADP security case study threat analysis data which will be used to assist in risk analysis, assistance visits, and requirements reviews.

Review, analyze for relevance, and publish a non-attributive summary of criminal cases relating to computers on a semi-annual basis. The primary source for this review will be closed AFOSI investigations. The intent is to show how and by whom computer systems are being exploited and, based upon the type of threat, aid in the development of countermeasures.

Consolidate threat information to formulate an overall ADP threat model.

Development and maintenance of the ADP Security Hazards Analysis and Reporting System is a requirement levied on the Air Force Computer Security Program Office. An extensive market survey indicates that the type and complixity of modeling required to satisfy this requirement is not available commercially. It may be available from academic or industry sources, but will require development to become a workable system that will satisfy Air Force requirements. ESD/TOEE

d. The objective of this project is to develop an Air Force military specification for a physically small, stand-alone, secure computer system which will support base-and-command-level requirements for classified and sensitive data processing. Hardware prototypes will be developed and at least two of them will be integrated and tested with security software.

The Air Force Computer Security Program Survey, completed in Sep 82, identified extensive requirements throughout the Air Force for sensitive and classified data processing. Currently, these requirements are satisified by using systems that are essentially designated for other uses (management support, logistics, communications, equipment test), most of them non-sensitive or non-classified applications. There is no manufacturer that provides a small computer specifically designed to support sensitive and/or classified processing. This project will develop the specifications needed to promote industry efforts and will standardize the system specifications for competitive, industry-wide efforts to provide this needed capability to a wide spectrum of Air Force activities ranging from System Program Offices to labs to Personnel Offices.

This is a new task defined to fulfill an urgent need for providing secure computer resources to accomplish a wide rage of classified and sensitive-unclassified processing requirements. The need for this task was identified when an intensive market survey disclosed that there is no manufacturer providing small secure computers for either the commercial or military markets. ESD/TOEE

e. The objective of this task is to provide acquisition guidelines for specifying computer security at the beginning of the system life cycle by: 1) identifying computer security requirements 2) specifying computer security measures and features, and 3) verifying the design, implementation, and operation of security features.

The purpose of the guidelines is to facilitate inclusion of computer security features at the outset of the system life cycle and to avoid or minimize retrofitting computer security measures at a later point in the system life. Retrofitting has been repeatedly demonstrated to be significantly more expensive and less effective than incorporation of the same measures during acquisition.

Development of the overview of computer security and verification is expected to be completed in early FY 83. The reamining phases of the project will satisfy an urgent Air Force need for definitive guidance on specifying computer security requirements during systems acquisition. Air Force Systems Command's Product Divisions will monitor/review this effort to insure the efforts expanded on embedded computer systems are comprehensive. ESD/TOEE

f. Develop a computer based risk analysis system providing comprehensive procedures and automated tools for use in identifying and evaluating computer security risks and evaluating cost effectiveness of protective measures. The protective measures will be used for safeguarding embedded computer resources and managemnt support facilities to include computer equipment, operating systems, and functional systems software. The system, titled Comprehensive Risk Analysis System (CRAS) will become a key component of the Air Force computer Security Risk Managment Program. After an analysis of current market products is completed, specifications for the systems and supporting computer resources will be developed. Using the specifications a system with computer resources will be procured.

The Air Force Computer Security Program Office has been directed to Develop tools, techniques, and guidelines to assist Air Force elements in assessing and meeting ADP security needs. Develop and test ADP risk analysis methodologies and ADP Security Test and Evaluation proceudres. Provide for Air Force-wide distribution and use.

Manual risk analysis systems have been shown to be far too cumbersome and expensive for field application. An analysis of current market products for risk analysis is underway. ESD/TOEE

16. Aerospace Ground Testing. Arnold Engineering Development Center (AEDC) conducts ground tests, engineering analyses, and technical evaluations of aerospace systems. For FY 83, AEDC is interested in any new and innovative ideas in the following areas:

a. Existing force measurement transducers used in both rocket and turbine engine thrust measurement systems deflect proportional to the applied load. This deflection (up to 0.03 inches) is undesirable as it requires a corresponding movement of the thrust mount system and test article with resultant tare and hysteresis problems. A zero-deflection thrust measurement system (for forces up to 30,000 lb) is needed and possibly could be implemented using a feedback force system to maintain the thrust mount system at null condition.

An additional benefit could be derived by measuring the restoration force outside of the test cell hostile environment. AEDC/DOT

b. Existing engine fuel flow measurement systems typically require the use of three sizes of flowmeters to cover the flow measurement range. Remotely actuated valves are used to select the proper size flowmeter depending on the flow rate. This technique is not adequate for transient flow measurements (engine accels, etc.) wherein the fuel flow rate varies over a wide range. The large size flowmeters must be selected for these type transients in order to handle the highest anticipated flowrate. As a result, flow measurement at the low flow rates (at the beginning of the accel) are of extremely poor quality. A flowmeter capable of covering the total measurement range (typically 500 to 70,000 pounds/hour) and providing 1.0 percent measurement uncertainty is needed. AEDC/DOT

c. No suitable instrumentation exists for measurements of heat transfer and erosion rate of diffusers during solid racket motor tests. These data are needed for assessment of water jacket design adequacy and improvement efforts associated with extending service life. Instrumentation compatible with rocket motor burn times from 10 to 120 seconds at heat transfer rates to 200 BTU/ft^2 - second and erosion rates of .006 inches/minutes for metal liners is needed. AEDC/DOT

d. Measurement of unsteady pressures in turbine engine and rocket tests can be adversely influenced by the response of the transducers and associated plumbing. Frequency, amplitude phase, and linearity effects of the transducer and attached tubing must be known when matching data requirements and transducer configurations.

Currently the ETF has no facilities for dynamic calibration of transducers and associated plumbing. Transducer response is generally based on manfacturer's data and the effects of plumbing (0.1" to 100" tubing lengths and .001 in^3 volume) based on past experience and calculations. Determining the response by these methods is highly unreliable and causes large data uncertainties. A plan for performing dynamic pressure transducer calibrations from 0.1 to 1.0 psi RMS, 10 Hz to 5 KHz, with flexibility for in-place calibrations, would allow producing more reliable and accurate test data. AEDC/DOT

e. No high quality low range (1 and 2 PSID) pressure transducers exist which are suitable for AP measurements in high vibration, high temperature and varying line pressure environments typically encountered in turbojet engine testing. Transducers are needed which can be installed on inlet ducting and provide one percent data for periods up to one year. AEDC/DOT

f. During Air Force missions, aircraft are sometimes subject to icing conditions. In order to accomplish the missions, aircraft designers need an understanding of the ice shedding phenomenon. The object would be to develop a computer code that would analyze ice shapes accreted on aircraft structures. Experimental verification/calibration of the ice shedding model could be accomplished in the icing research test cell at the Engine Test Facility at AEDC. AEDC/DOT

g. A liquid droplet dynamics study capability on a lab scale is needed to reduce energy intensive testing presently required to produce gross effects

data. This requires the development of a laboratory based droplet dynamics facility capable of characterizing shear, impingement, and vaparization mechanism. AEDC/DOT

17. Armament Technology. The Armament Development and Test Center (ADTC) develops, tests, and acquires all air armament, aerial targets, range instrumentation, electronic warfare threat simulators, and electromagnetic warfare systems. For FY 83, ADTC is interested in any new and innovative ideas in the following areas:

a. Spread Spectrum Receiver for Missile Applications. The objective of this program is to review the Soviet development of threat spread spectrum systems and to examine current and future US technology for missile receivers to be used in anti-radiation homing missiles. The output of this effort would be used to structure future studies and technology programs for ARH missile application. AD/XRCS

b. Missile Guidance Law. For a boost glide type missile, a guidance law will be develped to steer a missile from point A to point B with three sigma limits placed upon x, y, z, and t and point B specified for min-max value (relative to point A). AD/XRCS

c. Air-to-Space Intercept Guidance Laws. Guidance will be designed to intercept switches in low orbits with air launched conventional missiles. On board implementation will be discussed. AD/ZRCD

d. Optimization Computer Algorithms. Computer codes will be developed or adapted that solve two point boundary value problems as formulated by the Pontryagain Maximum Principle. Applications will address optimal energy management problems of air launched missiles. The codes will be compatible with the VAX II computer and use PLOT 10 graphics for interactive use. AD/XRCD

18. The Ballistic Missile Office (BMO). The BMO is responsible for formulation and management of all strategic missile programs and projects, in various stages of including basing options, research and exploratory, advanced and engineering development. The BMO is interested in any new and innovative ideas. In particular for FY 83, the BMO is interested in ideas in the following areas:

a. Advanced Antenna Window Application. Some advanced vehicles currently being defined by Advanced Strategic Missile Systems require microwave antenna windows. These windows have requirements outside the domain of windows developed for Ballistic Reentry Vehicles (BRV). An example of two vehicles with divergent requirements which would use the advanced windows are Defense Suppression Weapon (DSW) and an advanced air-to-air ballistic intercept missile (BIM).

The DSW is a small maneuvering vehicle which improves the penetration of BRV's by causing the expenditures of anti-BRV weapons. To promote the expending of these weapons, the DSW has the capability of destroying key defensive radars by non-nuclear methods. The DSW is guided to these radar targets by the target signal. The DSW uses only received signals. No guidance transmitter is onboard the DSW. Unsymmetric window ablation during reentry introduces large errors which affect the desired CEP. Special receive only antenna windows are

needed to preserve the CEP.

The BIM is a maneuvering vehicle designed to destroy aircraft beyond the range of availabe fighter aircraft. The ballistic capability is used to reduce the time to target. To accomplish this mission the BIM must acquire and close on the aircraft during reentry. This engagement results in long time reentry relative to BRV's (minutes for BIM as compared to seconds for BRV). This long flight time, combined with the severity of reentry, results in internal heat conduction problems not encountered in BRV's. Additionally, the large number of windows required for the precision tracking results in structural and microwave interaction problems. Special windows to resolve these unique problems are needed.

Phase 1: The program will define the special antenna window requirements of the BIM and DSW in conjuction with BIM and DSW guidance contractors. Based upon the requirements, concepts to improve the antenna window will be developed and coordinated with the guidance contractors.

Phase 2: The most viable concepts developed for each vehicle will be fabricated and subjected to ground tests to validate all critical aspects (meets the requirements). BMO/SYMS

b. Solid Particle Measurement in a Rocket Exhaust. The current state-of-the-art of rocket engine design involves the formation of solid or liquid particulate in the expansion section of the nozzle. The particulate is derived from certain gaseous species (e.g., Al_2O_3) that are formed during the normal high temperature (6500°F) combustion process. After burning, these gases flow through the nozzle throat and into the nozzle expansion section where the gas temperature characteristically drops to or well below 2600°F, depending on the final nozzle expansion ratio (i.e., is 1st, 2nd or 3rd stage). Sometime in this expansion process, the subject gases condense into a liquid (boiling temperature of Al_2O_3-6300°F) or further to a solid (fusion temperature of Al_2O_3-3600°F). This affects the system design in two ways. first, the condensing particles produce a "hole" in the expanding gases; that is, potential expanding gases are eliminated from the expansion process which reduces the potential deliverable thrust of the engine. Not only is this undesirable effect present, but the newly formed particle, through drag on the non-condensable gases, acts to further retard the expansion of these thrust producing gaseous components. The amount of this "flow drag" depends on the number and size of these particles. Second, the density of the condensed particle is much greater than that of the "carrier" gas so they do not move with the gas streamlines, but rather tend to remain on the velocity path they had at the time of formation. If the formed particles are small, they are more inclined to follow the gas; if large, they will generally continue their original trajectory. This is particularly true at low expansion pressures so this effect is more prevalent in 2nd and 3rd stages. The first effect reduces the overall thrust of a given engine which, since the mass flow is fixed, reduces the I_{SP} of the engine. Estimates by Air Force Rocket Propulsion laboratory (and corroborated by Aerojet) indicate that up to 15 seconds of I_{SP} could be recovered if this effect were eliminated. The second effect is less important and results in nozzle erosion. In the case of Peacekeeper 2nd stage, the erosion process actually removed some of the later expansion sections of the nozzle.

Thus a knowledge of the particulate size and velocity distributions are

important to the research to effect propellant and expansion performance and to the nozzle designer to ensure structural integrity. Yet there currently exists no proven way of measuring these particulates during nozzle operation. In prior programs, Advanced Strategic Missile Systems has breadboarded and tested, in arc driven nozzles, a laser device designed to measure particulate in a flowing stream. The contractor that performed that work has been contacted and is in a position to try to make such a measurement. Since the devise works using scattered laser radiation, the major feasibility issue is associated with the background radiation of the rocket exhaust gases in the rocket exhaust. That is, the device will have to detect the scattered light pulses derived from the instantaneously eliminated particle and yet reject the exhaust derived radiation. This has been characteristically done in other radiation environments, but not in this environment, which will probably contain large amounts of radiation in select wavelengths. BMO/SYMS

19. Aeronautical Systems Technology. The Aeronautical Systems Division (ASD) has the overall responsibility for the acquisition of all aeronautical systems/subsystems and associated equipment. ASD exercises responsibility for development, test, and evaluation of all of this program. For FY83, ASD is interested in any new and innovative ideas in the following areas:

a. Head Up Display Proliferation of Symbology and Terms.

Modern Head Up Displays (HUDs) are being designed to be used for low altitude, terrain following operations in less than optimal visibility conditions. As such, symbology on the HUD provides some basic information for instrument flight and navigation (no forward visibility) while the outside visual or FLIR scene provides the "real world" input the pilot needs for mission flexibility, display system correlation and target verification. Essentially what we are doing is instrumenting visual flight. In this context, and as we continue to press toward the goal of a night adverse weather delivery capability, extreme care must be taken in the selection of information to be displayed, symbols used to display that information and the way these symbols are mechanized. Of equal importance is the terminology used to describe the system(s) and convey to the pilot procedures and techniques that will assure safe and efficient use.

Unfortunately, the HUD is suffering from a lack of standardization and a proliferation of terms used to describe the same display feature. For example, the -0- symbol is referred to as the Total Velocity Vector (TVV), Flight Path Marker (FPM) and Velocity Vector (VV) in different applications. HUD features providing steering commands (pitch and bank steering bars in the heads down flight director system) are referred to as Course Command, Horizontal and Vertical Bars, Flight Director, etc.

This variety of descriptors complicates use of these systems from the design stage through the systems integration process to cockpit application. The solution of these problems will require a carefully structured set of development tests that insure that the fundamental information requirements for safe and precise instrument flight are provided in a usable format. In subsequent steps to include navigation information (vertical and lateral) and target symbology we must insure that the added symbols do not reduce the pilot's ability to control the aircraft safely. Finally, system monitoring, fault detection and failure annunciation must be approached carefully to insure that

the pilot is advised of any display problems.

One fundamental initial need, if the effort is to succed, is to establish a common language to be used by display designers, systems integrators, evaluators and users alike. The function of a variety of new HUD symbols is not intuitively obvious and we need, in one document (perhaps a data base) an accepted name for each display element, a description of how the element works (in a language that can be understood by the user) and recommended procedures for using each feature). ASD/ENASI

b. Develop Cost Analysis software for Contract Administration Organizations (CAOs). The Underlying Learning Curve approach received recognition as the most outstanding research in cost and price analysis in 1982 at the Federal Acquisition Research Symposium. This project would develop user friendly software to perform the cost tracking function at the CAO utilizing the Underlying Learning Curve approach. This would enable the approach to be utilized throughout the Department of Defense as efficiently as possible without creating an undue training load. ASD/YZDB

D.4 DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

I Submitting Proposals

The responsibility for carrying out the DARPA SBIR Program is vested in the Program Management Office. The DARPA Coordinator and Manager of the program is Mr. John K. Meson.

DARPA invites the small business community to send proposals directly to DARPA under the following address:

Defense Advanced Research Projects Agency
Program Management Office
ATTN: Mr John K. Meson
1400 Wilson Boulevard
Arlington, VA 22209

The proposals will be processed in the Program Management Office and distributed to appropriate technical offices for evaluation and action.

DARPA identified 8 technical topics to which the small business can respond. A brief description of each topic is included below.

II TOPICS

1. SMALL UNDERSEA POWER SOURCES

Recent advances in low power integrated circuitry, as well as low threshold optical sources, allows the operation of a fiber optic repeater in the ocean at a power of less than 1 watt. This, in turn, opens the possibility of autonomously powered repeaters in a fiber optic telemetry cable system. Thus, the weight and expense of supplying power for repeaters and sensors through the trunk cable can be eliminated, and this can save an order of magnitude in the size of the trunk line cable. Unfortunately, present batteries available for the powering of repeaters are relatively expensive, and it is predicted that within a repeater module, the battery would be the most expensive component. Present technology suggests the use of a lithium thionyl chloride battery which would cost between $5,000 and $10,000.

The purpose of the proposed research effort is to investigate novel methods of supplying approximately 1 watt of electrical power for 1 year on the ocean sea bed. The power source must be easily transportable, deployable under military conditions, and have minimal volume. In addition, it must be safe to handle, and obviously must not depend upon light as an energy source. Three approaches are known at this time: Sea water batteries, radioisotope thermo-electric generators (RTG's), and optical powering.

(a) Sea Water Batteries. The government is undertaking some research in this area, using the cathodic corrosion of, say, magnesium or aluminum in sea water to produce low voltage (about 1 volt) at low current levels. This research is directed at a specific application, and further basic research is warranted in the selection of materials, the build-up of hydrogen on the cathode and its elimination with low water flow over the active surface, low power dc-to-dc converters to boost cell voltages of 1 volt to 5 to 25 volts, and the shape and material of the cathode.

(b) Radioisotope Thermo-electric Generators (RTG's). RTG's have been available to supply power in remote areas for sometime. In use on the sea bed for fiber optic repeaters, a number of difficulties arise concerning the safety of the nuclear material. Present designs for RTG's primarily use uranium or plutonium as the fuel, which has difficulties because of the toxicity of the material and its by-products and international controls on accountable weapons grade materials. The research should focus on the possibility of other less toxic isotopes, which could still supply the now-reduced power requirements, and be less politically sensitive.

(c) Optical Powering. If attenuation in optical fibers continues to drop, and the efficiency with which light can be converted into electrical energy increases, it may be possible to supply some or all of the power to such a repeater through a set of optical fibers. The object of this research would be to characterize, as a function of light attentuation in fibers, the extent to which a transmission link could be optically powered. The analyses should include an estimate of the light-to-electric power conversion efficiency, source power required, receiver sensitivity, repeater spacing possible, and available fiber telemetry data rate. The thrust of the effort is to determine at what fiber attentuation levels, and with what light-to-electrical conversion efficiencies, light powering of fiber-optic repeaters become a practical matter.

2. NEW TECHNIQUES APPLICABLE TO BIO-CHEMICAL TECHNOLOGY PROGRAM

New classes of chemical ultrasensors offer promise of broad applicability to defense-related strategic and tactical issues including both CBW and non-CBW problems. Current interest focuses on the development of elementary sensor components which offer single-molecule sensitivity, extraordinary specificity, and the intrinsic potential for applicability to a very wide range of target molecules. Particular interest exists in membrane-bound receptor systems with good dynamic range.

3. NEW DISPLAY TECHNOLOGIES

There are presently a variety of display technologies, including CRT displays, liquid crystals, electrophoretic, and electroluminescence. No single technology can be scaled to handle a range of displays ranging from hand held to blackboard sized. New concepts for low power, high resolution displays are being sought with emphasis on extensible designs that can be realized in hand held sizes and blackboard sizes.

4. ADVANCED NON-DESTRUCTIVE INSPECTION TECHNIQUES

New, high performance structural materials for advanced weapon system applications depend on non-destructive inspection to insure that flaws do not exist which will compromise overall reliability and component lifetime requirements. For some materials and components it is anticipated that inspection techniques will have to be capable of achieving resolution in the range of tens of microns, not only for quantitative sizing of defects, but also for determining their precise location. Unique, new approaches, which have the clear potential of satisfying this demanding resolution requirement are needed.

5. ADVANCED COMMUNICATIONS

(a) Underwater Acoustic Communication Channels. For some years, the Navy has been interested in exploring alternatives for underwater acoustic communications for command and control of both submerged submarines and fixed underwater asets. Among the systems which have been deployed with varying degrees of success are the so-called "Underwater Telephone," the Integrated Acoustic Communication System (IACS), and several approaches using explosive sound sources. Simultaneously, the oil industry has developed many variants of underwater control and telemetry systems, generally based on coded acoustic tone, intended for use with both underwater vehicles and well head equipment at ranges on the order of a kilometer. For many recent applications of interest, communication ranges on the order of 200 km, with data rates of 10 bits/second would be operationally useful, but no known existing approach can supply this performance at acceptable error rates (less than 10^{-3} per bit). To some extent, data rate and range can be traded off against each other, but it is also strongly desirable that candidate systems and approaches should be maximally covert and minimally susceptible to enemy jamming. Two-way communication is required in many applications, and power demands should thus be commensurate with limitations imposed by small, remote, unmanned platforms.

New approaches are sought to solve the communications problem posed above. It is anticipated that investigation of candidate systems would be divided into two phases:

(1) Conceptual waveform and channel design, with theoretical and analytical assessment based on existing environmental and experimental data describing propagation characteristics.

(2) Based on successful theoretical results, fabrication of prototype equipment and experimental verification of competing approaches by means of critical demonstrations at sea.

(b) Multiple Access and Control in Hostile Areas. Novel techniques for control of, and report back from, distributed sensors operating in denied or hostile geographical areas are needed. The sensors cannot be expected to retain long term synchronization without external control. Hence communication to and from the sensors must be controlled external to the overall system. A study detailing methods of achieving the overall control is desired. It is believed that knowledge of advanced multiple access communication techniques is required and must be included in the analysis.

6. ADVANCED MONOLITHIC MICROWAVE TEST INSTRUMENTATION

Recent advances in monolithic microwave integrated circuits will make it possible to incorporate complete transmit/receive and phase shifter functions on a single chip. Great savings in cost and the possibility of implementing new systems are expected because of improved efficiency in manufacture and test of these devices. Full potential for cost savings are only possible if the production check out and testing of these circuits can be automated. There is a need to develop automated test hardware and software for high volume pass/fail microwave chip testing.

7. NEW TECHNIQUES FOR RAPID, MICROSCALE CHARACTERIZATION OF COMPOUND SEMICONDUCTORS

Compound semiconductors, such as the GaAs-based III-V alloys, and HgCdTe, potentially will have widespread use in DoD systems. Rapid, high spatial resolution ($\lesssim$1 MICRON) instruments are needed for materials development and quality control purposes if these materials systems are to be developed to maturity suitable for manufacturing purposes. Proposed concepts/approches should have one or more of the following potential capabilities: (1) Measure lateral alloy uniformity to $\leq \pm 0.002$ mole fraction with a lateral spatial resolution $\lesssim$1 MICRON x 1 MICRON and depth resolution $\lesssim$200 Å; (2) alloy composition vs. depth to ± 0.002 mole fraction with depth resolution $\lesssim$50 Å and lateral resolution $\lesssim$50 MICRON x 50 MICRON; (3) Minority carrier properties (e.g., lifetime and mobility) with spatial resolution similar to those stated in (1) and (2), above. The proposed techniques should be compatible with commercialization (e.g., not dependent on a fixed major facility), and incorporation and use in an electronics manufacturing environment.

New microscale characterization techniques which may not meet the spatial resolution goals described above, but would provide novel and unique insight into the nature and properties of compound semiconductor structures, also will be considered. First priority, however, will be given to new techniques which do offer the potential to meet the spatial resolution goals.

8. SPECIAL OPERATIONS TECHNOLOGY

A lightweight flexible waterproof closure which will withstand two atmospheres pressure and can be incorporated in an outer garment or diving suit is required in the Special Operatons arena. This item needs to be long-lived, and capable of repeated opening and closing without loss of its waterproof quality. Additionally, Special Operations needs include:

o a lightweight, compact solar powered distillation/purification device which will serve to make non-potable water drinkable;

o a compact, lightweight, colorless aerosol glue and aerosol glue-dissolvent which will not harm or discolor clothing;

o a lightweight flexible membrane which is readily permeable to oxygen but impervious to carbon dioxide;

o a "breathable" (allows vapor to escape) clothing material where the K value (insulation value) can be changed to accommodate different temperatures or weather conditions; and

o an innovative concept for extracting personnel by air where VTOL and hover aircraft capability cannot be used.

D.5 SUBMITTING PROPOSALS ON DEFENSE NUCLEAR AGENCY TOPICS

The Defense Nuclear Agency is seeking Small Business firms with a strong research and development capability and experience in nuclear weapons effects and nucelar weapons phenomenology areas. Proposals and any questions concerning the research topics should be submitted to

Defense Nuclear Agency
DDST (EA)
Washington, D.C. 20305
Attn: Maj. John Keane
202/325-7300

The research categories proposed for study under this program are:

Nuclear Weapons Phenomenology,
Nuclear Weapons Effects,
Simulation,
Instrumentation,
Directed Energy Effects,
Nuclear Hardening and Survivability,
Security of Nuclear Weapons,
Testing and Analysis of Materials/Structures,
Operational Planning,
Nuclear Weapons Employment Policy Issues

These topics are further explained below.

Additional information beyond that provided herein may be otained by request from the address given above.

DEFENSE NUCLEAR AGENCY
Research Topics

1. Nuclear Weapons Phenomenology

Nuclear weapons phenomenology includes blast, shock, thermal radiation, and nuclear radiation. A basic understanding of the phenomenology associated with nuclear weapons effects of a mechanical nature and mechanisms for measuring that phenomenology under various conditions are areas of particular interest.

2. Nuclear Weapons Effects

Nuclear weapons effects includes: ground shock, water shock, cratering, electromagnetic pulse, radiation effects on material, electronics and personnel, and dynamic loading. Of particular interest is the response of materials, structures, and systems to these nuclear weapons effects. Materials of interest include metals, ceramics and composites. Any new material capable of being used as a structural member is of particular concern for aircraft, missiles, ships (both surface and subsurface) and military vehicles. The response of underground structures, such as missile silos, command and control facilities and communications facilities are especially important. Also of interest are transient and permanent radiation effects on electronics and sensors.

3. Simulation

Simulation of nuclear weapons effects includes: high explosive testing to simulate the mechanical effects, emp simulation, thermal radiation simulation, and nuclear radiation simulation. These simulation techniques should be as realistic as possible, relatively inexpensive to perform and comparable to actual nuclear weapons effects in a manner which can be correlated and documented. Improvements to nuclear simulations should also address their possible use in a training and/or operational sense for combat troops. An extensive program currently exists for all areas of simulation and one should become familiar with those to see how they can be improved and/or combined in order to make the total process more realistic and more representative of an actual nuclear weapons effect.

4. Instrumentation

Instrumentation is for measuring nuclear weapons effects and phenomenology and the response of test items exposed to these weapons effects. The instrumentation should be capable of operating under very harsh conditions, such as might be encountered in an underground nulcear test, a high explosive test, or test involving high levels of x-ray, gamma, or neutron radiation. The instrumentation should, for the most part, be survivable and include recording data transmission and data analysis capabilities.

5. Directed Energy Effects

The effects of directed energy (e.g., lasers) sources on materials, structures and systems are of interest. Of particular interest are the identification of the correlation between nuclear weapons effects and directed energy effects, the identification of materials which are capable of withstand-

ing both nuclear weapons effects and directed energy effects, and mechanisms by which the directed energy effects actually interact with target materials/ structures.

6. Nuclear Hardening and Survivability

Techniques for nuclear hardening and survivability of systems/structures against nuclear weapons effects and, where compatible, directed energy effects are important. These techniques should be designed to protect the structure or system against the combined effects of blast, thermal and nuclear radiation in the cases of structures or materials, and should also provide protection against electromagnetic and radiation effects wherever any electronic capabilities are involved. In particular, the ability to harden communications facilities and surveillance sensors against electromagnetic pulses is paramount.

7. Security of Nuclear Weapons

Measures to improve the security of nuclear weapons against all possible threats are of great concern. This includes the design of security features both for the actual weapons and for the facilities in which weapons are either stored or transported. These security measures should be designed to protect against all known or predicted threats and should be done in such a way as to avoid making the protected item visible as a target.

8. Testing and Analysis of Materials/Structures

DNA is interested in developing techniques for testing and analysis of materials/structures by both destructive and non-destructive means, with special emphasis on non-destructive testing.

9. Operational Planning

The nuclear employment planning capabilities of operational commanders in strategic and integrated warfare environments should be improved. Improvements desired include development of automated planning systems, techniques to determine target damage objective and criteria, target damage assessment capabilities, and automated nuclear weapon employment codes.

10. Nuclear Weapons Employment Policy Issues

Nuclear weapons employment policy issues include the study of aspects of enduring conflict scenarios, how to enhance deterrence, and alternative employment strategies.

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